

Construction Specification Manual

Salt River Project

Technical Specification Index – January 2026

Division 25

Division	Title	Updated
DIVISION 25: INTEGRATED AUTOMATION		
250000	Requirements for Integrated Automation	Revised 01/26
250000	Appendix A – Object Naming Standard	Revised 06/23
250000	Appendix B – Graphical Standard for Niagara 4	Revised 06/23
250000	Appendix C – Device Data Spreadsheet	Revised 06/23
250000	Appendix D – Object Naming Spreadsheet	Revised 06/23
250923	Instrumentation and Controls for HVAC	Revised 01/26
251100	Network Devices	Revised 06/23
251200	Network Configuration	Revised 06/23
251500	Software	Revised 01/26

SECTION 25 00 00**INTEGRATEDAUTOMATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. This section includes general requirements for the SRP building automation system.
- B. Related Sections:
 - 1. 01 91 00 Commissioning Program
 - 2. 01 91 13 General Commissioning Requirements
 - 3. 23 08 00 Commissioning of HVAC
 - 4. 25 09 23 Instrumentation and Controls for HVAC
 - 5. 25 11 00 Integrated Automation Network Devices
 - 6. 25 12 00 Integrated Automation Network Configuration
 - 7. 25 15 00 Integrated Automation Software
- C. Coordination with other trades is required wherever architectural features govern the location of work.

1.2 REFERENCES

- A. Any rules and regulations of Federal, State, local authorities, and utility companies in force throughout the contract duration.
- B. Appendix A Object Naming Standard
- C. Appendix B Graphic Standard for Niagara N4
- D. Appendix C Device Data Spreadsheet
- E. Appendix D Object Naming Spreadsheet
- F. Agencies relevant to this specification:
 - 1. ANSI American National Standards Institute
 - 2. ASHRAE American Society of Heating, Refrigeration, and Air-Conditioning Engineers
 - 3. BTL BACnet Testing Laboratories
 - 4. FCC Federal Communications Commission
 - 5. IEC International Electrotechnical Commission
 - 6. ISO International Organization for Standardization NEC National Electrical Code

- 7. NEMA National Electrical Manufacturers Association
- 8. OSHA Occupational Safety and Health Administration
- 9. UL Underwriters Laboratories

G. Publications relevant to this specification:

- 1. ANSI/ASHRAE Standard 135-2016, A Data Communication Protocol for Building Automation and Control Networks
- 2. ASHRAE 223P (expected 2019) - Designation and Classification of Semantic Tags for Building Data
- 3. ISO 16484-5:2017 - Building Automation and Control Systems (BACS) -- Part 5: Data communication protocol

1.3 ACRONYMS

- A. B-AAC BACnet Advanced Application Controller - Profile with criteria defined by BACnet International
- B. B-ASC BACnet Application Specific Controller - Profile with criteria defined by BACnet International
- C. B-BC BACnet Building Controller - Profile with criteria defined by BACnet International
- D. BAS Building Automation System – The primary software used to read and/or write data to any building system.
- E. BBMD BACnet Broadcast Management Device capable of forwarding BACnet broadcast messages across subnetworks.
- F. BIBB BACnet Interoperability Building Blocks – Standardized documentation of a devices BACnet functionality across the network.
- G. BTL BACnet Testing Laboratories supports interoperability testing for BACnet device
- H. EMS Energy Management System
- I. COV Change of Value - Trending increment that records data every time a value changes a pre-specified amount.
- J. DDC Direct Digital Controller containing internal programming logic and input/output capabilities and is typically directly associated with equipment
- K. PID Proportional, Integral, Derivative - Control algorithm used to adjust an output based upon the difference between a process variable and setpoint variable
- L. INT Interval - Trending increment that records data on a pre-defined time interval.
- M. IP Internet Protocol - Set of rules governing the format of data sent over the internet or other networks

N.	GUI	Graphical User Interface – Term for any graphical pictation allowing user to read/write data
O.	LAN	Local Area Network – A collection of devices interconnected in one physical location
P.	O&M	Operations and Maintenance – Term to define documentation that illustrates both the operation and maintenance of a product.
Q.	PICS	Protocol Implementation Conformance Statement used to describe the BACnet capabilities of a device
R.	SaaS	Subscription as a Service – Service or application subscribed for use on while on a re-occurring payment.
S.	SLA	Service Level Agreement - A commitment between a service provider and a client.
T.	UDP	User Datagram Protocol
U.	XML	Extensible Markup Language - A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

1.4 DEFINITIONS

A.	Algorithm	A process or set of rules to be followed in calculations or other problem-solving operations.
B.	BACnet	Building Automation and Control Networks communication protocol developed by ASHRAE.
C.	BACnet Object	The concept of organizing BACnet information into standard components with various associated properties.
D.	Bridge	A repeater that connects two LANs on same network protocol across different data link layers
E.	Cloud	Referencing any data storage on an off-site location not maintained by the client
F.	Controls Contractors	The contractors installing and configuring the devices being installed on the SRP network
G.	Date of acceptance	The date determined between SRP and the contractor that the equipment is finalized and tested, and is turned over to SRP
H.	Device	Term for any type of DDC or network component used for monitoring or control
I.	Enterprise	Software used to satisfy the needs of an organization. Used as the interface for all integrated building management equipment.
J.	Ethernet	A computer networking architecture consisting

		of various local-area networking protocols and devices
K.	Equipment	Term referencing a controlled component
L.	FAULT	BACnet Notification state indicating that loss of communication or sensor
M.	Firmware	Permanent software programmed into read-only memory and provides low level hardware control
N.	Gateway	Connects two dissimilar protocols by translating the data from one system to another system.
O.	Integration Contractor	The contractors responsible for the integration of the devices being installed on the SRP network.
P.	Integration Project	Any project requiring data passing between installed controls any SRP systems, including the BAS Supervisor.
Q.	Hub	A common connection point for devices on a network
R.	Integrate	The act of connecting disparate BMS systems to a common platform
S.	Integrator	Integrates one system into another by acting as both a router and a gateway, and is capable of other functions including trending, scheduling, notifications, and other programming features.
T.	IP Address	A unique string of numbers separated by periods that identifies each computer using the internet protocol to communicate over a network.
U.	Loop	Synonymous with PID
V.	OFFNORMAL	BACnet Notification state indicating that a parameter is met to indicate an off normal event.
W.	Network	Multiple devices communicating with one another
X.	Non-Programmable	A device that has pre-programmed language or logic that cannot be re-written or only has pre-selectable options
Y.	Notification Object	A BACnet Object that is used to send event notifications, including alarms, within a BACnet System
Z.	Object	Data or packet or data on a network
AA.	SRP	Referring to Salt River Project or representative approved by SRP
BB.	Points	Software representation of virtual and physical inputs and outputs
CC.	Programmable	A device that does not have any pre-programmed language or logic.

DD.	Repeater	A device used to replicate signal data to increase transmission distance
EE.	Router	Routes data packets across IP addresses on different LANs/WANs with the ability to allow or deny
FF.	Subnet	Also known as a subnetwork, is a logical subdivision of a network
GG.	System	Term referencing multiple pieces of equipment acting in conjunction

1.5 SYSTEM DESCRIPTION

- A. SRP has standardized an open system architecture for complete integration of new and existing components of the building automation system. This open system standardization will ensure continued building automation system interoperability between all sub-systems.
- B. This standardized system must have the ability to allow for stand-alone operation of any sub system in the event of communication failure.

1.6 SUBMITTAL REQUIREMENTS

- A. All submittals must meet the requirements of Section 01 33 00.
- B. All submittals listed in this division document are in addition to the respective division submittal requirements.
- C. Submittals must be reviewed by SRP and/or a consultant for SRP for conformity with the design intent. Execution of work will not be performed until SRP has approved submittals.
- D. Manufacturer datasheets that contain a series of components must clearly indicate the specific component that is applicable to this project. Each submitted piece of manufacturer literature will clearly reference the specification or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.
- E. Contractor is required to provide their submittals in a timely manner to allow for timely review, resubmittal as needed, and final approval before proceeding with work. Failure to submit in timely manner does not alleviate Contractor from meeting the project schedule unless they receive approval of schedule change by SRP.
- F. The following submittal documentation process is required to be completed throughout the life of the project. The basis of design for these submittals are defined as follows:
 - 1. DEVICE CONFIGURATION – A template XLSX document

provided to the Controls Contractor by SRP that contains a comprehensive list of required device information that the Controls Contractor must collect, as well as an SRP pre-approved list of Device IDs pertaining to all integrated devices that the Controls Contractor must use. This document will be utilized by the Integration Contractor to ensure proper integration into the Building Management System and will be provided to SRP for filing at project completion.

2. **DEVICE OBJECT IDENTIFICATION** – A template XLSX document provided to the Controls Contractor by SRP to identify the objects that will be available on the network. This will include the object name matching the SRP standard, and identify the trending, notifications, and configuration for each individual object per device. For Programmable devices, this includes every object. For Non-Programmable devices, this will include only the approved object to be proxied, and the additional information for configuration to be done by the Integration Contractor on the Niagara Supervisor.
3. **DEVICE LAYOUT** – A PDF document created by the Controls Contractor for each unique device indicating detailed wiring diagram for each of its components, all panel and component information including quantity and model numbers, location of power source feeding device(s). Document also to include the device model, series, location, and network configuration.
4. **NETWORK LAYOUT** – A PDF document created by the Controls Contractor to indicate in a traditional line diagram how existing and new devices in the project will be interconnected and how they will reside on the SRP network. This will indicate not only the type of device, but also protocol, and at completion include the network configuration.

1.7 SUBMITTALS

- A. The following will be provided as part of the initial submittal package:
 1. Cover page and table of contents for all submitted hardware, software, etc.
 2. **Network Hardware Product Data** – Provide manufacturer's technical literature for each specified integration device. Minimum technical data requirements must include device dimensions, performance characteristics, electrical characteristics, and installation/startup instructions.
 3. **Field Device Product Data** – Provide manufacturer's technical literature for each specified integration device. Minimum technical data requirements must include device dimensions, performance characteristics, electrical characteristics, and installation/startup instructions. See Section 250923 Instrumentation and Controls for HVAC for additional submittal instructions.
 4. PICS statement, BIBB, and BTL listing documents for all BACnet devices.
 5. Documentation stating conformance to Modbus Organization for all Modbus devices.

6. Software Product Data - Provide manufacturer's technical literature for the programming software required for each specified integration device. Minimum technical data requirements must include operating system requirements, system resource requirements, programming style, network support, and any required 3rd party drivers and/or applications.
7. Project Team Qualifications – Provide Controls Contractor and Integration Contractor team qualifications. The project team or teams are required to meet the minimum amount personnel noted in Section 25 00 00, Subsection 3.2. Project team qualifications must meet or exceed the contractor requirements noted in Section 25 00 00, Subsection 1.8.
8. Device Configuration - The information required for initial prior to network addressing assignments includes the following:
 - a. Device Name following the SRP standard naming
 - b. Device Description describing all the equipment, systems, or portions of that will be controlled or monitored with the device.
 - c. Manufacturer
 - d. Model number
 - e. Series
 - f. Firmware version
 - g. Protocol
9. Network Layout – The information required for initial approval prior to product procurement includes the following:
 - a. All devices being installed with device name following the SRP standard naming
 - b. Any network devices required to be used as gateways or integrators
 - c. Manufacturer and model number for each device
 - d. Any existing devices that will be utilized on the network including data sharing across the LAN network
 - e. Labeling of all networks with protocol type and communication wire type specified or existing.
10. Device Object Identification – The information required for initial approval requires for following for non-programmable devices, and only hardwired objects for programmable devices.
 - a. Object Name following the SRP standard naming
 - b. Raw Object Name if Object Name cannot be changed internal to the device
 - c. Object Type
 - d. Object Description
 - e. Object Engineering Units
 - f. Object Precision
 - g. Object Trend Type and Configuration
 - h. Object Notification Configuration
11. Schedule of work indicating:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and

- e. equipment and expected lead times
 - e. Milestones indicating restraints on work by other trades or situations
 - Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- B. The following will be provided as part of the Programming Submittal package:
- 1. Cover page and table of contents for every page/document included in the submittal package:
 - 2. Device Configuration – Continuation of Device Configuration requiring the following information before submittals can be approved are as follows:
 - a. Network ID for each individual network
 - b. Device IDs for each device
 - c. DHCP configuration for IP devices
 - d. Previous device in daisy chain installation
 - e. Hosted Network Information
 - 3. System Graphics – A graphical representation will be presented for each unique system. All graphics provided by the Integration Contractor in this submittal will be based on the SRP graphical standard.
 - 4. Network Layout – An update of the Network Layout with the following information:
 - a. Network ID for each individual network
 - b. Device IDs for each device
 - c. IP address or Device Instance Number for each device
 - d. Switch ID
 - e. Port ID
 - 5. Device Layout – A PDF layout for each unique device requiring the following information:
 - a. Device layout with enclosure information, enclosure ID, device name, IP address of Device ID, and manufacturer and model number
 - b. Connection to all peripheral equipment with point naming matching the SRP standard, wiring layouts, and bill of material including manufacturer, part numbers, and quantities.
 - c. Location of installation for each device and expansion module including panel numbers
 - d. Power wiring including power source location, electrical panel number, and breaker number.
 - e. Communication wiring including the previous and next device if daisy chain configuration, and switch/port information if IP device.
 - 6. Hardware and Software requirements for any proposed software installations as stated in section 25 15 00 *Integrated Automation Software*.
- C. A checkout form will be provided as part of the Commissioning Process for each device and will include the following:
- 1. Prefunctional Test
 - 2. Functional Performance Test

3. Point-to-point testing
4. Device Communication Status
5. Communication Errors and Repair Requirements
6. GUI Function Tests at All Operator Stations

- D. The following will be provided as part of the final close-out package:
1. Cover page and table of contents for every page/document included in the close- out package
 2. Final Network Layout Document in PDF and VISIO format
 3. Final Device Configuration Document in XLSX and PDF format
 4. Final Device Object Identification in XLSX format
 5. Final Device Layout for each unique device with final updated information, in PDF format
 6. User manuals for all installed or updated software, or any web-based software required for device configuration or programming.
 7. Back-up documents for all configured devices, named with the date of back-up and the device name
 8. O&M manuals in PDF including the following:
 - a. Instructions on how to perform any functions, features, etc. mentioned during customer training. This includes any technical manuals for programming and control loop tuning
 - b. Complete set of software engineering manuals
 - c. Complete system design and engineering manuals as used by manufactures
 - d. Copies of all software used for programming and device configuration
 - e. Hardware and software maintenance instructions
 - f. Equipment submittals, parts lists, installation instructions, etc.
 - g. Licensing and warranty information
 9. Deficiency log for any devices or components on pre-existing devices identified during execution of project.

1.8 QUALITY ASSURANCE

- A. Coordinate all related network infrastructure changes with SRP. Any changes to network components or infrastructure without prior authorization from SRP is not permitted.
- B. The Contractor must have a minimum of five (5) years of demonstrated technical expertise with building automation systems as well as any subsystem requiring integration during the project duration.
- C. The Contractor will have successfully completed Niagara 4 Basic Operator system training. Upon request, Contractor will present record of completed training including course outlines.

- D. Materials and equipment will be the catalogued products of manufacturers who regularly engage in production and installation of building automation systems. Materials and equipment will be the manufacturer's latest design that complies with the specification requirements.
 - E. SRP reserves the right to make the final determination of the qualifications of any Contractor's employees and will have the Contractor's employees removed from the project if they so choose. SRP will make a request in writing to Contractor citing the circumstances and the Contractor will replace any unqualified employee within three (3) business days with no impact to project schedule.
 - F. Station review must be completed in an interactive working session with SRP personnel. At the conclusion of each review session, a copy of any JACE or Supervisor station backup will be provided in .dist format and submitted to SRP for record purposes.
 - 1. All hardware, software, components, and accessories must be:
 - a. New from the factory
 - b. In production and not a legacy product
 - c. Supported by the manufacturer
 - d. Free of defects
 - e. Provided by the same manufacturer for each product type throughout the duration of the project
 - G. Follow project communication protocol for all correspondence. Any changes, decisions, etc. must be properly documented. Verbal interpretations, clarifications, conversations, etc., are non-binding without proper documentation.
 - H. RFIs sent to SRP are to address individual requests only with a proposed solution. Multiple issues or incomplete RFI's will be rejected. RFIs will include, but not limited to, the following:
 - 1. Referenced Drawing
 - 2. Referenced Specification Number/Section
 - 3. Contact Person
 - 4. Request and Proposed Solution
 - I. RFI answers are for clarification only and do not authorize additional work or change orders.
- 1.9 WARRANTY
- A. Warranty documentation will be submitted for acceptance to SRP upon completion of the project.
 - B. Vendor specific warranty information will be provided as part of the Contractor warranty documentation. Any manufacturer's warranty that exceeds 24 months will be extended to SRP.

- C. Device failures during the warranty period will be adjusted, repaired, or replaced with no additional cost to SRP.
- D. Any standard troubleshooting or routine maintenance completed by SRP will not void any warranty or incur any additional costs.
- E. Contractor will respond during normal business hours within 24 hours of a warranty service request.
- F. All corrective software modifications made during the warranty period will be updated on all project documentation and updated software files will be provided to SRP for record purposes.
- G. Software fixes and firmware updates will be covered throughout the warranty duration with no additional cost to SRP. With approval of SRP and assurance that no existing equipment connections will be adversely affected, patches and updates will be applied within 72 hours of becoming available from the manufacturer.
- H. At the end of the warranty period, the Contractor will be responsible for verifying any instance of Tridium Niagara software and firmware is updated to the latest revision.
- I. Expiration of the warranty period does not relieve the Contractor of the responsibility to:
 - 1. Correct all deficiencies identified during the warranty period
 - 2. Fulfill all specified obligations during the warranty period
- J. The Contractor will not be required to warranty reused devices, except those that have been rebuilt or repaired. Reused devices must demonstrate they are in operable condition at the time of acceptance.
- K. Parts, labor, and travel will be included during the warranty duration.

1.10 OWNER TRAINING

- A. Owner training for integrated equipment will be performed by the Integration Contractor and will be specific to the building management system and any subsystem integrated during the project.
- B. Training will not be scheduled until all integrated systems and GUI components are completed, functional and approved by SRP.
 - 1. If device integration coincides with other subsystem installation, owner training for subsystems may be completed in parallel with training mentioned within this specification.
- C. Based upon project size, a minimum of 8 hours of training will be provided to SRP, organized into two (2) separate sections at four (4) hours a piece, unless otherwise stated by SRP.

- D. Provide a factory-trained instructor or representative to give full instructions to designated personnel in the operation, maintenance, and programming of each piece of equipment or system. Instructors shall be thoroughly familiar with all aspects of the subject matter. The Contractor will provide all equipment and material required for classroom training.
 - E. Proposed training instructor qualifications will be provided to SRP and subject to approval by SRP.
 - F. Training will include classroom instruction and hands-on field instruction.
 - G. Minimum requirements for classroom instruction are the following:
 - 1. Review of project record documentation
 - 2. Maintenance procedures and schedules
 - 3. Any pertinent safety requirements
 - 4. Operator control functions
 - 5. GUI navigation, including:
 - a. Login/logout procedures, password setup, and audit log reporting
 - b. Menu penetration and broad overview of the various functions and features
 - 6. Explanation of Supervisor and JACE station backup procedures
 - 7. Explanation of procedures to restore any Niagara database.
Scenarios to explain include:
 - a. Corrupted database restoration
 - b. Restoration of database in a new JACE replacing a failed JACE
 - 8. A detailed review of Niagara wire sheet programming, trending, and alarm database management.
 - 9. Training manuals will be provided and include screen captures with detailed instructional annotation for each step required to complete all portions of SRP training.
 - 10. Additional topics can be requested by SRP in advance of the training sessions. Each additional topic will require the Contractor to prepare and submit training manuals with the same level of detail as described above.
 - 11. All training is subject to be recorded by SRP for internal use.
 - H. Minimum requirements for field instruction:
 - 1. Walkthrough of the project to locate integrated components
 - 2. Demonstration of operation from Supervisor to integrated equipment
- 1.11 OWNERSHIP OF PROPRIETARY MATERIAL
- A. Project specific software and all related documentation will become the property of SRP. This includes, but is not limited to, the following:
 - 1. Graphical Templates

2. Project Record Drawings
3. Station Databases
4. Custom Logic

PART 2 - PRODUCTS

- 2.1 See Section 250923 Instrumentation and Controls for HVAC.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Perform site inspection prior to work performed to verify equipment can be installed as noted in the project documentation.
- B. Report any discrepancies, conflicts, inadequate conditions, or omissions related to project documentation to Engineer. Resolution must be provided prior to starting rough-in work. Report unacceptable conditions immediately.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate work with work of others. The Contractor will perform, at the Contractor's expense, necessary changes in specified work caused by failure or neglect to report discrepancies.
- D. Promptly request clarification and instruction related to project documentation through the proper RFI procedure.

3.2 PROJECT MANAGEMENT

- A. The Contractor will provide the following:
 1. One employee of the Contractor whose primary responsibility is managing the project. Herein, this person will be known as the Contractor's Project Manager
 2. One employee of the Contractor whose primary responsibility is supervising installation of the physical building management system hardware. Herein, this person will be known as the Contractor's Installation Supervisor
 3. One employee of the Contractor whose primary responsibility is to program controllers, program the building management system database, and implement naming and graphical standards provided by SRP. Herein, this person will be known as the Contractor's Chief Programmer.
 - a. Based on the size of the project, more than one programmer, who is an employee of the Contractor, may be utilized. Herein, these people will be known as the Contractor's Assistant Programmers

- b. Any work performed by the Contractor's Assistant Programmers must be checked and verified by the Contractor's Chief Programmer prior to implementation

3.3 BUILDING MANAGEMENT SYSTEM SWITCH OVER

- A. Switch over from the existing building management system to the new building management system will be coordinated with SRP. A representative of SRP may be on site during switch over.
- B. Any required downtime to subsystems scheduled for integration into the building management system will be limited to 24 hours.
 1. For integration of HVAC equipment, space temperatures must be maintained in occupied spaces levels approved by SRP throughout the duration of any expected building management system downtime.
- C. Sufficient testing of equipment scheduled for integration will be completed before switchover to ensure readiness, including point to point checkouts and functional testing if necessary.
- D. Functional performance tests of integrated equipment will be performed once integration and switch over has been completed.
 1. Functional performance tests will comply with Division 1, Sections 01 91 00 and Section 25 09 23.
 2. Demonstration of control loop response and adherence to sequences of operation will not be required for integrated field devices not scheduled for replacement, unless otherwise specified by SRP.
 3. The Contractor will allow time to perform function tests of all integrated equipment with a consultant on behalf of SRP prior to project completion.

3.4 BUILDING MANAGEMENT SYSTEM EQUIPMENT DEMOLITION

- A. Demolition of existing building management system hardware and/or software scheduled for replacement will not occur until SRP has confirmed demolition may commence.
 1. The Contractor will be responsible for steps taken to minimize equipment outages wherever possible.
 2. A demolition plan will be submitted to SRP for approval. The demolition plan must be submitted no later than two weeks prior to commencement of work on site.
 3. Demolished building management system hardware will be handed over to SRP once demolition is complete, unless otherwise stated by SRP.

**END OF
SECTION**

APPENDIX A – OBJECT NAMING STANDARD

1.1 SUMMARY

- A. The Object Naming Standard will pertain to all new BACnet devices.
- B. Standard objects include:
 - 1. Schedule Objects.
 - 2. Trend Objects.
 - 3. Notification (Alarm) Objects.
 - 4. Control and Monitoring Objects.
- C. Existing devices will not be required to adhere to the Object Naming Standard, unless otherwise specified by SRP.
 - 1. If the Object Naming Standard is requested for use by SRP for existing devices, it is the responsibility of the Controls Contractor to investigate object character limitations for older controller lines before implementation.
- D. Object names will be the combination of several elements that are represented by a standardized list of abbreviations.
 - 1. If an abbreviation for a new object does not exist in this naming standard, the Integration Contractor will generate a new object based upon the standardized list of abbreviations. This new object will then be submitted to SRP for approval prior to implementation.

1.2 OBJECT NAMING STRUCTURE

- A. Object names will be structured as follows:
 - 1. [Device Identifier]_[Object Identifier]
- B. Device Identifier Structure:
 - 1. Will be provided to the Controls Contractor by SRP alongside the Device Configuration spreadsheet.
 - 2. Will mimic the asset management identifiers currently in place at SRP.
 - 3. Structure:
 - a. [Site][Building][Equipment Type][Floor][Equipment Number]
 - 4. Characters will total of 10 or 11.
 - a. 11 characters are permitted for equipment counts greater than 99 on a single floor (e.g. VAVs).
 - b. For all other equipment, maximum allowable characters will be 10.
- C. The Object Identifier will be named accordingly based upon the object function and will adhere to the standardized abbreviations noted within this appendix.
- D. Spaces and special characters are not permitted for use in the object naming structure.
 - 1. Underscores (“_”) are the exception and may be used in lieu of an empty space between the Device Identifier and the Object Identifier.

- E. Complete Object Name Example:
 - 1. Credit Union Building, Building 1, Air Handler 1, First Floor, Supply Fan 1 Enable.
 - a. CU01AHU101_SaFan1Ena.

1.3 ABBREVIATIONS AND TYPICAL SYSTEM OBJECTS

A. Site Locations

- 1. 16 – 16th Street Facility.
- 2. 27 – 27th Street Facility.
- 3. CO – Corbell Data Center.
- 4. CU – Credit Union Building.
- 5. EV – East Valley Service Center.
- 6. FH – Fountain Hills.
- 7. FT – Foothills Training Center.
- 8. IS – Information Services Building.
- 9. KY – Kyrene Generating Station.
- 10. PA – Project Administration Building.
- 11. PB – Papago Buttes Facility.
- 12. PC – Pinal Customer Center.
- 13. PO – Power Operations Building.
- 14. SB_ Studio Technology Building
- 15. SH – Sky Harbor.
- 16. SS – Southside Water Facility.
- 17. ST – San Tan Generating Station.
- 18. TE – Tempe Service Center.
- 19. WV – West Valley Service Center.
- 20. XC – Crosscut Facility.

B. Equipment

- 1. AHU – Air Handling Unit.
- 2. ACU – Air Conditioning Unit.
- 3. BOI – Boiler.
- 4. CHL – Chiller.
- 5. CAC – Computer Room Air Conditioning Unit.
- 6. CTW – Cooling Tower.
- 7. EVC – *Evaporative Cooler*
- 8. FCU – Fan Coil Unit.
- 9. FPB – Fan Powered Box.
- 10. MTR_ Domestic Water meter
- 11. MUA – Makeup Air Unit.
- 12. PMP – Pump.

13. ACU – Roof Top Unit/Air Conditioning Unit.
14. VAV – Variable Air Volume Unit.
 - a. Note: VAV encompasses all terminal unit types.

C. Cooling (Air)/Heating (Air)/Actuated Objects

1. Coil Objects:
 - a. Coil objects will be prepended with the system type (xxx). System types include:
 - i. Chw – Chilled Water.
 - ii. DirEvap – Direct Evaporative.
 - iii. Hw – Hot Water.
 - iv. IndEvap – Indirect Evaporative.
 - b. Hardwired Input Objects:
 - i. (xxx)CoilEntAirTmp – Coil Entering Air Temperature (°F).
 - ii. (xxx)CoilLvgAirTmp – Coil Leaving Air Temperature (°F).
 - iii. (xxx)CoilRTmp – Coil Water Return Temperature (°F).
 - iv. (xxx)CoilSTmp – Coil Water Supply Temperature (°F).
2. Staged Objects.
 - a. Staged objects will be prepended with the system type (xxx) followed by the stage number (n).
 - b. Example: DX Stage 1 | DxStg1
 - c. System types include:
 - i. Dx – Direct Expansion.
 - ii. ElecHt – Electric Heating.
 - iii. GasHt – Gas Heating.
 - d. Where only a single stage exists within the system, object will still be named “Stg1”.
 - e. Hardwired Input Objects:
 - i. (xxx)Stg(n)Alm – Stage Alarm (Alarm/Normal).
 - ii. (xxx)Stg(n)EntAirTmp – Stage Entering Air Temperature (°F).
 - iii. (xxx)Stg(n)LvgAirTmp – Stage Leaving Air Temperature (°F).
 - iv. (xxx)Stg(n)Sts – Stage Status (On/Off).
 - f. Hardwired Output Objects:
 - i. (xxx)Stg(n)Cmd – Stage Command (On/Off).
 - ii. (xxx)Stg(n)Ena – Stage Enable (On/Off).
 - g. Virtual Read Only Objects:
 - i. (xxx)Stg(n)FailAlm – Stage Fail Alarm (Alarm/Normal).
 - ii. (xxx)Stg(n)HandAlm – Stage in Hand Alarm (Alarm/Normal).
 - iii. (xxx)Stg(n)Lckout – Stage Lockout (Locked Out/Normal).
 - iv. (xxx)Stg(n)LpTm – Stage Loop Time Setpoint (Minutes).
 - v. (xxx)Stg(n)RnTm – Stage Run Time (Hours).
 - h. Virtual Read/Write Objects:
 - i. (xxx)Stg(n)FailAlmDly – Stage Fail Alarm Delay (Seconds).
 - ii. (xxx)Stg(n)HandAlmDly – Stage in Hand Alarm Delay (Seconds).
 - iii. (xxx)Stg(n)IntDly – Stage Delay (Seconds).
 - iv. (xxx)Stg(n)LckoutRst – Stage Lockout Reset (Reset/Off).
 - v. (xxx)Stg(n)LpBiasSp – Stage Loop Bias Setpoint (n/a).
 - vi. (xxx)Stg(n)LpDbSp – Stage Loop Deadband Setpoint (Varies).
 - vii. (xxx)Stg(n)LpDGainSp – Stage Loop Differential Gain Setpoint (n/a).
 - viii. (xxx)Stg(n)LpIGainSp – Stage Loop Integral Gain Setpoint (n/a).

- ix. (xxx)Stg(n)LpPGainSp – Stage Loop Proportional Gain Setpoint (n/a).
 - x. (xxx)Stg(n)MinOffTm – Stage Minimum Off Time (Minutes). (xxx)Stg(n)MinOnTm – Stage Minimum On Time (Minutes).
 - xi. (xxx)Stg(n)OffDly – Stage Off Delay (Seconds).
 - xii. (xxx)Stg(n)OnDly – Stage On Delay (Seconds).
3. Actuated Objects (Valves and Dampers):
- a. Objects will be prepended with two parts. First is system type (xxx) followed by equipment designation (yyy).
 - b. Example: Chilled Water Valve | ChwVlv
 - c. Valve objects will be prepended with the system type (xxx). System types include:
 - i. BrlIso – Boiler Isolation. Typically, only used in plant related systems.
 - ii. ChlrlIso – Chiller Isolation. Typically, only used in plant related systems.
 - iii. Chw – Chilled Water.
 - iv. DirEvap – Direct Evaporative.
 - v. Hw – Hot Water.
 - vi. HxIso – Heat Exchanger Isolation. Typically, only used in plant related systems.
 - vii. IndEvap – Indirect Evaporative.
 - viii. TwrlIso – Tower Isolation. Typically, only used in plant related systems.
 - d. Damper objects will be prepended with the system type (xxx). System types include:
 - i. Ea – Exhaust Air.
 - ii. Ma – Mixed Air.
 - iii. MinOa – Minimum Outside Air.
 - iv. Oa – Outside Air.
 - v. Ra – Return Air.
 - vi. Sa – Supply Air. Will also be used for VAV and Fan Powered Box dampers.
 - e. Equipment designations (yyy) include:
 - i. Dmp – Damper.
 - ii. Vlv – Valve.
 - f. Hardwired Input Objects:
 - i. (xxx)(yyy)ClsSts – Closed Status (On/Off).
 - ii. (xxx)(yyy)OpnSts – Open Status (On/Off).
 - iii. (xxx)(yyy)Pos – Position (%).
 - g. Hardwired Output Objects:
 - i. (xxx)(yyy)ClsEna – Closed Enable (On/Off).
 - ii. (xxx)(yyy)Cmd – Command (%).
 - iii. (xxx)(yyy)Ena – Enable (On/Off).
 - iv. (xxx)(yyy)OpnEna – Open Enable (On/Off).
 - h. Virtual Read Only Objects:
 - i. (xxx)(yyy)FailAlm – Fail Alarm, General (Alarm/Normal).
 - ii. (xxx)(yyy)FailClsAlm – Fail Closed Alarm (Alarm/Normal).
 - iii. (xxx)(yyy)FailOpnAlm – Fail Open Alarm (Alarm/Normal).
 - iv. (xxx)(yyy)Lckout – Lockout (Locked Out/Normal).
 - i. Virtual Read/Write Objects:
 - i. (xxx)(yyy)FailAlmDly – Fail Alarm Delay (Seconds).
 - ii. (xxx)(yyy)FailDifSp – Fail Alarm Differential Setpoint (%).
 - iii. (xxx)(yyy)LckoutRst – Lockout Reset (Reset/Off).
 - iv. (xxx)(yyy)LpBiasSp – Loop Bias Setpoint (n/a).

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- v. (xxx)(yyy)LpDbSp – Loop Deadband Setpoint (%). (xxx)(yyy)LpDGainSp – Loop Differential Gain Setpoint (n/a).
- vi. (xxx)(yyy)LpIGainSp – Loop Integral Gain Setpoint (n/a).
- vii. (xxx)(yyy)LpPGainSp – Loop Proportional Gain Setpoint (n/a).
- viii. (xxx)(yyy)LpTm – Loop Time Setpoint (Minutes).
- ix. (xxx)(yyy)MaxPos – Maximum Position Setpoint (%).
- x. (xxx)(yyy)MinPos – Minimum Position Setpoint (%).

D. Filter Objects

1. Filter objects will be prepended with the filter type (xxx). Filter types include:
 - a. Flt – Filter, Generic.
 - b. FinFlt – Final Filter.
 - c. OaFlt – Outside Air Filter.
 - d. PreFlt – Pre-Filter.
 - e. RaFlt – Return Air Filter.
2. Virtual Read Only Objects:
 - a. (xxx)Alm – Alarm, General (Alarm/Normal).
3. Virtual Read/Write Objects:
 - a. (xxx)AlmDly – Alarm Delay (Seconds).

E. Measurements (Air)

1. Measurement objects will be prepended with the system type (xxx) and measurement designation (yyy).
2. System types include:
 - i. Bldg – Building.
 - ii. Da – Discharge Air.
 - iii. Ea – Exhaust Air.
 - iv. Ma – Mixed Air.
 - v. Oa – Outside Air.
 - vi. Ra – Return Air.
 - vii. Rm – Room.
 - viii. Sa – Supply Air.
 - a. Discharge air will be used with equipment supplying air to a room or zone, and supply air will be used with equipment supplying air to downstream equipment (e.g. VAV air handler supplying terminal units).
3. Measurement designations include:
 - a. CO2 – Carbon Dioxide (ppm).
 - b. DewTmp – Dewpoint Temperature (°F).
 - c. Hum – Humidity (%).
 - d. StPr – Static Pressure (in/Wc or psi).
 - e. Tmp – Dry Bulb Temperature (°F).
 - f. VelFlow – Velocity Flow (fpm).
 - g. VolFlow – Volumetric Flow (cfm).
 - h. WbTmp – Wet Bulb Temperature (°F).
4. Hardwired Input Objects:
 - a. (xxx)(yyy) – Shows current sensed value (Varies).
5. Virtual Read Only Objects:
 - a. (xxx)(yyy)HiAlm – High Alarm (Alarm/Normal).
 - b. (xxx)(yyy)LoAlm – Low Alarm (Alarm/Normal).

- c. (xxx)(yyy)SpDifAlm – Differential Setpoint Alarm (Alarm/Normal).
- 6. Virtual Read/Write Objects:
 - a. (xxx)(yyy)HiAlmDly – High Alarm Delay (Seconds).
 - b. (xxx)(yyy)HiSp – High Setpoint (Varies).
 - c. (xxx)(yyy)LoAlmDly – Low Alarm Delay (Seconds).
 - d. (xxx)(yyy)LoSp – Low Setpoint (Varies).
 - e. (xxx)(yyy)MaxSp – Maximum Setpoint (Varies).
 - f. (xxx)(yyy)MinSp – Minimum Setpoint (Varies).
 - g. (xxx)(yyy)Sp – Setpoint (Varies).
 - h. (xxx)(yyy)SpDif – Differential Setpoint (Varies).
 - i. (xxx)(yyy)SpDifAlmDly – Differential Setpoint Alarm Delay (Seconds).
- F. Measurements (Water)
 - 1. Measurement objects will be prepended with the system type (xxx) and measurement designation (yyy).
 - 2. System types include:
 - a. Chw – Chilled Water.
 - b. Cw – Condenser Water.
 - c. HxChw – Heat Exchanger Chilled Water.
 - d. HxCw – Heat Exchanger Condenser Water.
 - 3. Measurement designations include:
 - a. DifPr – Differential Pressure (in/Wc or psi).
 - b. RPr – Return Pressure (in/Wc or psi).
 - c. RTmp – Return Temperature (°F).
 - d. RVelFlow – Return Velocity Flow (fps).
 - e. RVolFlow – Return Volumetric Flow (gpm).
 - f. SPr – Supply Pressure (in/Wc or psi).
 - g. STmp – Supply Temperature (°F).
 - h. SVelFlow – Supply Velocity Flow (fps).
 - i. SVolFlow – Supply Volumetric Flow (gpm).
 - 4. Alarm Objects:
 - 5. Hardwired Objects:
 - a. (xxx)(yyy) – Shows current sensed value (Varies).
 - 6. Virtual Read Only Objects:
 - a. (xxx)(yyy)HiAlm – High Alarm (Alarm/Normal).
 - b. (xxx)(yyy)LoAlm – Low Alarm (Alarm/Normal).
 - c. (xxx)(yyy)SpDifAlm – Differential Setpoint Alarm (Alarm/Normal).
 - 7. Virtual Read/Write Objects:
 - a. (xxx)(yyy)HiAlmDly – High Alarm Delay (Seconds).
 - b. (xxx)(yyy)HiSp – High Setpoint (Varies).
 - c. (xxx)(yyy)LoAlmDly – Low Alarm Delay (Seconds).
 - d. (xxx)(yyy)LoSp – Low Setpoint (Varies).
 - e. (xxx)(yyy)MaxSp – Maximum Setpoint (Varies).
 - f. (xxx)(yyy)MinSp – Minimum Setpoint (Varies).
 - g. (xxx)(yyy)Sp – Setpoint (Varies).
 - h. (xxx)(yyy)SpDif – Differential Setpoint (Varies).
 - i. (xxx)(yyy)SpDifAlmDly – Differential Setpoint Alarm Delay (Seconds).

G. Modes (Air)

1. Mode objects will be prepended with the mode type (xxx).
2. Mode types include:
 - a. ClMode – Cooling Mode.
 - b. DehumMode – Dehumidifying Mode.
 - c. EconMode – Economizer Mode.
 - d. FanMode – Fan Mode.
 - e. HmdMode – Humidifying Mode.
 - f. HtMode – Heating Mode.
 - g. VentMode – Ventilation Mode.
3. Fan Mode will only utilize Enable and Runtime objects.
4. General Virtual Read Only Objects:
 - a. (xxx)RnTm – Runtime (Hours).
5. General Virtual Read/Write Objects:
 - a. (xxx)Ena – Enable (On/Off).
 - b. (xxx)MinOffTm – Minimum Off Time (Minutes).
 - c. (xxx)MinOnTm – Minimum On Time (Minutes).
 - d. (xxx)OffDly – Off Delay (Seconds).
 - e. (xxx)OnDly – On Delay (Seconds).
6. Temperature Only Read/Write Virtual Points:
 - a. (xxx)DaTmpOffDifSp – Discharge Air Temperature Off Differential Setpoint (°F).
 - b. (xxx)DaTmpOnDifSp – Discharge Air Temperature On Differential Setpoint (°F).
 - c. (xxx)OaEnaDb – Outside Air Enable Deadband (°F).
 - d. (xxx)OaEnaSp – Outside Air Enable Setpoint (°F).
 - e. (xxx)RmTmpOffDifSp – Room Temperature Off Differential Setpoint (°F).
 - f. (xxx)RmTmpOnDifSp – Room Temperature On Differential Setpoint (°F).
 - g. (xxx)SaTmpOffDifSp – Supply Air Temperature Off Differential Setpoint (°F).
 - h. (xxx)SaTmpOnDifSp – Supply Air Temperature On Differential Setpoint (°F).
7. Humidity Only Read/Write Virtual Points:
 - a. (xxx)RaHumOffDifSp – Return Air Humidity Off Differential Setpoint (%).
 - b. (xxx)RaHumOnDifSp – Return Air Humidity On Differential Setpoint (%).
 - c. (xxx)RmHumOffDifSp – Room Humidity Off Differential Setpoint (%).
 - d. (xxx)RmHumOnDifSp – Room Humidity On Differential Setpoint (%).
8. Ventilation Only Read/Write Virtual Points:
 - a. (xxx)RaCO2OffDifSp – Return Carbon Dioxide Off Differential Setpoint (ppm).
 - b. (xxx)RaCO2OnDifSp – Return Carbon Dioxide On Differential Setpoint (ppm).
 - c. (xxx)RmCO2OffDifSp – Room Carbon Dioxide Off Differential Setpoint (ppm).
 - d. (xxx)RmCO2OnDifSp – Room Carbon Dioxide On Differential Setpoint (ppm).

H. Motor Controlled Objects (Fans and Pumps)

1. Objects will be prepended with the system type (xxx), equipment designation (yyy), and the equipment number (n).

2. Where only an air system contains a single fan or a coil booster pump, the object will drop the number (n).
3. Example: Exhaust Fan 1 | EaFan1.
4. Fan objects will be prepended with the system type (xxx). System types include:
 - a. Ea – Exhaust Air.
 - b. Oa – Outside Air.
 - c. Ra – Return Air.
 - d. Sa – Supply Air.
 - e. Twr – Tower. Typically, only used in plant related systems.
5. Pump objects will be prepended with the system type (xxx). System types include:
 - a. Chw – Chilled Water.
 - b. Cw – Condenser Water Pump.
 - c. DirEvap – Direct Evaporative.
 - d. Hw – Hot Water.
 - e. IndEvap – Indirect Evaporative.
 - f. PriChw – Primary Chilled Water. Typically, only used in plant related systems.
 - g. SecChw – Secondary Chilled Water. Typically, only used in plant related systems.
6. Equipment designations (yyy) include:
 - a. Fan – Fan.
 - b. Pmp – Pump.
7. Alarm Objects:
8. Hardwired Input Objects:
 - a. (xxx)(yyy)(n)Alm – Alarm (Alarm/Normal).
 - b. (xxx)(yyy)(n)Cur – Current (A).
 - c. (xxx)(yyy)(n)Spd – Speed (%).
 - d. (xxx)(yyy)(n)Sts – Status (On/Off).
9. Hardwired Output Objects:
 - a. (xxx)(yyy)(n)Cmd – Command (On/Off).
 - b. (xxx)(yyy)(n)Ena – Enable (On/Off).
10. Virtual Read Only Objects:
 - a. (xxx)(yyy)(n)Cur – Current (A).
 - b. (xxx)(yyy)(n)Enrg – Energy (kW).
 - c. (xxx)(yyy)(n)EnrgTot – Total Energy (kW).
 - d. (xxx)(yyy)(n)FailAlm – Fail Alarm (Alarm/Normal).
 - e. (xxx)(yyy)(n)Frq – Frequency (Hz).
 - f. (xxx)(yyy)(n)HandAlm – Hand Alarm (Alarm/Normal).
 - g. (xxx)(yyy)(n)Lckout – Lockout (Locked Out/Normal).
 - h. (xxx)(yyy)(n)MtrTmp – Motor Temperature (°F).
 - i. (xxx)(yyy)(n)OffDly – Off Delay (Seconds).
 - j. (xxx)(yyy)(n)OnDly – On Delay (Seconds).
 - k. (xxx)(yyy)(n)Pwr – Power (kW).
 - l. (xxx)(yyy)(n)RnTm – Runtime (Hours).
 - m. (xxx)(yyy)(n)Spd – Speed (%).
 - n. (xxx)(yyy)(n)VAC – Volts AC (V).
 - o. (xxx)(yyy)(n)VfdAlm – VFD Alarm (Alarm/Normal).
 - p. (xxx)(yyy)(n)VfdTmp – VFD Temperature (°F).

- q. (xxx)(yyy)(n)Warn – Internal VFD Warning (Warning/Normal).
11. Virtual Read/Write Objects:
- a. (xxx)(yyy)(n)AutoMode – Auto Mode (On/Off).
 - b. (xxx)(yyy)(n)FailAlmDly – Fail Alarm Delay (Seconds).
 - c. (xxx)(yyy)(n)HandAlmDly – Hand Alarm Delay (Seconds).
 - d. (xxx)(yyy)(n)LckoutRst – Lockout Reset (Reset/Off).
 - e. (xxx)(yyy)(n)LpBiasSp – Loop Bias Setpoint (n/a).
 - f. (xxx)(yyy)(n)LpDbSp – Loop Deadband Setpoint (%).
 - g. (xxx)(yyy)(n)LpDGainSp – Loop Differential Gain Setpoint (n/a).
 - h. (xxx)(yyy)(n)LpIGainSp – Loop Integral Gain Setpoint (n/a).
 - i. (xxx)(yyy)(n)LpPGainSp – Loop Proportional Gain Setpoint (n/a).
 - j. (xxx)(yyy)(n)LpTm – Loop Time Setpoint (Minutes).
 - k. (xxx)(yyy)(n)MinOffTm – Minimum Off Time (Minutes).
 - l. (xxx)(yyy)(n)MinOnTm – Minimum On Time (Minutes).
- I. Optimization Objects and Setpoints:
1. Basic Temperature Control Setpoints (Air):
- a. Temperature control objects will be prepended with the occupancy type (xxx), followed by the conditioning designation (yyy).
 - b. Occupancy types include:
 - i. Occ – Occupied
 - ii. Unocc – Unoccupied
 - c. Conditioning designations include:
 - i. Ht – Heating.
 - ii. Cl – Cooling.
 - d. Virtual Read Only Objects:
 - i. (xxx)(yyy)RnTm – Run Time (Hours).
 - e. Virtual Read/Write Objects:
 - i. (xxx)(yyy)MinOffTm – Minimum Off Time (Minutes).
 - ii. (xxx)(yyy)MinOnTm – Minimum On Time (Minutes).
 - iii. (xxx)(yyy)TmpSp – Temperature Setpoint (°F).
 - iv. (xxx)(yyy)TmpDif – Temperature Differential (°F).
 - v. (xxx)(yyy)DaTmpSp – Discharge Air Temperature Setpoint (°F).
 - vi. (xxx)(yyy)SaTmpSp – Supply Air Temperature Setpoint (°F).
2. Optimized Start Read Only Virtual Objects:
- a. OptStrtAvgZnTmp – Optimized Start Average Zone Temperature (Multizone, °F).
 - b. OptStrtClSts – Optimized Start Cooling Status (On/Off).
 - c. OptStrtHtSts – Optimized Start Heating Status (On/Off).
 - d. OptStrtLastStrtTm – Optimized Start Next Start Time (Date/Time).
 - e. OptStrtMaxStrtTm – Optimized Start Maximum Start Time (Hours).
 - f. OptStrtMinStrtTm – Optimized Start Minimum Start Time (Hours).
 - g. OptStrtNextOccTm – Optimized Start Next Occupied Time (Date/Time).
 - h. OptStrtNextStrtTm – Optimized Start Next Start Time (Date/Time).
 - i. OptStrtZnTmp – Optimized Start Average Zone Temperature (Single Zone, °F).
3. Optimized Start Read/Write Virtual Objects:
- a. OptStrtClEna – Optimized Start Cooling Enabled (On/Off).
 - b. OptStrtClSp – Optimized Start Cooling Setpoint (°F).

- c. OptStrtHtEna – Optimized Start Heating Enabled (On/Off).
- d. OptStrtHtSp - Optimized Start Heating Setpoint (°F).
- 4. Optimized Stop Read Only Virtual Objects:
 - a. OptStopAvgZnTmp – Optimized Stop Average Zone Temperature (Multizone, °F).
 - b. OptStopLastStopTm – Optimized Stop Next Stop Time (Date/Time).
 - c. OptStopMaxStopTm – Optimized Stop Maximum Stop Time (Hours).
 - d. OptStopMinStopTm – Optimized Stop Minimum Stop Time (Hours).
 - e. OptStopNextOccTm – Optimized Stop Next Occupied Time (Date/Time).
 - f. OptStopNextStopTm – Optimized Stop Next Stop Time (Date/Time).
 - g. OptStopZnTmp – Optimized Stop Average Zone Temperature (Single Zone, °F).

J. Plant Objects:

- 1. Building Load Objects:
 - a. Building load objects will be prepended with the system type (xxx).
 - b. System Types Include:
 - i. Chlr – Chiller.
 - ii. Blr – Boiler.
 - c. Alarm Objects:
 - i. (xxx)FailAlm – Fail Alarm (Alarm/Normal).
 - ii. (xxx)FailAlmDly – Fail Alarm Delay (Seconds).
 - iii. (xxx)HandAlm – Hand Alarm (Alarm/Normal).
 - iv. (xxx)HandAlmDly – Hand Alarm Delay (Seconds).
 - v. (xxx)Lckout – Lockout (Locked Out/Normal).
 - vi. (xxx)LckoutRst - Lockout Reset. Alarm (Reset/Off).
 - d. Hardwired Input Objects:
 - i. (xxx)Cap – Capacity (%).
 - ii. (xxx)Cur – Current (A).
 - iii. (xxx)Sts – Status (On/Off).
 - iv. (xxx)Alm – Alarm (Alarm/Normal).
 - e. Hardwired Output Objects:
 - i. (xxx)Ena – Enable (On/Off).
 - ii. (xxx)STmpSp – Supply Temperature Setpoint (°F).
 - f. Virtual Read Only Objects:
 - i. (xxx) Cap – Capacity (%). Used only if equipment has integration card and hard wiring is unavailable.
 - ii. (xxx) Sts – Status (On/Off). Used only if equipment has integration card and hard wiring is unavailable.
 - iii. (xxx)HeadPr – Head Pressure (in/Wc or psi).
 - iv. (xxx)RnTm – Run Time (Hours).
 - v. (xxx)Ton – Tonnage (Ton).
 - g. Virtual Read/Write Objects:
 - i. (xxx) STmpSp – Supply Temperature Setpoint (°F). Used only if equipment has integration card and hard wiring is unavailable.
 - ii. (xxx)Ena – Enable (On/Off). Used only if equipment has integration card and hard wiring is unavailable.
 - iii. (xxx)HeadPrSp – Head Pressure Setpoint (in/Wc or psi).
 - iv. (xxx)MinOffTm – Minimum Off Time (Minutes).
 - v. (xxx)MinOnTm – Minimum On Time (Minutes).

- vi. (xxx)OffDly – Off Delay (Seconds).
- vii. (xxx)OnDly – On Delay (Seconds).

K. Reset Objects:

1. Reset objects will be prepended with the system type (xxx), direction of flow (yyy) and measurement designation (zzz).
 - a. System types typically include:
 - i. Chw – Chilled Water.
 - ii. Hw – Hot Water.
 - iii. Oa – Outside Air. Typically, not used with Trim and Respond.
 - iv. Sa – Supply Air.
 - b. Direction of flow typically includes:
 - i. S – Supply
 - ii. R – Return.
 - c. Measurement designations typically include:
 - i. DiffPr – Differential Pressure (in/Wc or psi).
 - ii. StPr – Static Pressure (in/Wc or psi).
 - iii. Tmp – Temperature (°F).
 - d. Direction of flow is generally used for water system temperature only. If the object does not relate to a water system temperature, the direction of flow (yyy) is dropped from the object name.
 - e. Example: Supply Air Temperature Reset Setpoint | SaTmpRstSp
 - f. General Read Only Virtual Objects:
 - i. (xxx)(yyy)(zzz)RstTotZnReq – Reset Total Zone Requests (n/a).
 - g. General Read/Write Virtual Objects:
 - i. (xxx)(yyy)(zzz)RstSp – Reset Setpoint (Varies).
 - ii. (xxx)(yyy)(zzz)RstMinSp – Reset Minimum Setpoint (Varies).
 - iii. (xxx)(yyy)(zzz)RstMaxSp – Reset Maximum Setpoint (Varies).
 - iv. (xxx)(yyy)(zzz)RstInitSp – Reset Initial Setpoint (Varies).
 - v. (xxx)(yyy)(zzz)RstDlyTmSp – Reset Delay Time Setpoint (Minutes).
 - vi. (xxx)(yyy)(zzz)RstTmStepSp – Reset Time Step Setpoint (Seconds).
 - h. Trim and Respond Read/Write Virtual Objects:
 - i. (xxx)(yyy)(zzz)RstIgReqSp – Reset Ignored Requests Setpoint (n/a).
 - ii. (xxx)(yyy)(zzz)RstTrimSp – Reset Trim Setpoint (Varies).
 - iii. (xxx)(yyy)(zzz)RstRespSp – Reset Respond Setpoint (Varies).
 - iv. (xxx)(yyy)(zzz)RstRespRat – Reset Respond Rate (Minutes).
 - v. (xxx)(yyy)(zzz)RstRespMaxSp – Reset Maximum Respond Setpoint (Varies).
 - vi. ZnImpSp – Zone Importance Multiplier (n/a).
 - i. Demand Response Read/Write Virtual Objects:
 - i. (xxx)(yyy)(zzz)RstReqDnSp – Reset Requests Down Setpoint (Varies).
 - ii. (xxx)(yyy)(zzz)RstReqUpSp – Reset Requests Up Setpoint (Varies).

L. Schedule Objects

1. Schedule objects will be prepended with the system type (xxx). System types include:
 - a. Bldg – Building.
 - b. Sys – System or Unit.
 - c. HwPlnt – Hot Water Plant.
 - d. ChwPlnt – Chilled Water Plant.

2. Virtual Read Only Objects:
 - a. (xxx)SchedLastOccTm – Last Scheduled Occupied Time (Date/Time).
 - b. (xxx)SchedLastUnoccTm – Last Scheduled Unoccupied Time (Date/Time).
 - c. (xxx)SchedNextOccTm – Next Scheduled Occupied Time (Date/Time).
 - d. (xxx)SchedNextUnoccTm – Next Scheduled Unoccupied Time (Date/Time).
 - e. (xxx)SchedSts – Schedule Status (Occupied/Unoccupied).
3. Virtual Read/Write Objects:
 - a. (xxx)Sched – Schedule (Editable Schedule Object).

M. Rotation Objects:

1. Rotation objects can be prepended with the system type (xxx), equipment (yyy), a rotation designation (zzz), and the rotation number (n).
2. System types typically include:
 - a. PriChw – Primary Chilled Water.
 - b. SecChw – Secondary Chilled Water.
 - c. Cw – Condenser Water.
 - d. Hw – Hot Water.
3. Equipment types typically include:
 - a. Pmp – Pump.
 - b. Chlr – Chiller.
 - c. Blr – Boiler.
 - d. Hx – Heat Exchanger.
4. Rotation designations include:
 - a. Lead – Lead.
 - b. Lag – Lag.
 - c. Stby – Standby.
5. The rotation number (n) will only be used in instances where multiple pieces of equipment may be lead/lag/standby at once for the same system.
6. If the object is a chiller, tower, boiler, or heat exchanger, the system type (xxx) is dropped from the object name.
7. Virtual Read Only Objects:
 - a. (xxx)(yyy)(zzz)(n) – Shows current lead/lag/standby equipment.
 - b. (xxx)(yyy)NextRotTm – Next Rotation Time (Date/Time).
 - c. (xxx)(yyy)RotSeq – Rotation Sequence (Varies).
8. Virtual Read/Write Virtual Objects:
 - a. (xxx)(yyy)(zzz)(n)Ena – Enable (On/Off).
 - b. (xxx)(yyy)(zzz)(n)MinOffTm – Minimum Off Time (Minutes).
 - c. (xxx)(yyy)(zzz)(n)MinOnTm – Minimum On Time (Minutes).
 - d. (xxx)(yyy)(zzz)(n)OffDly – Off Delay (Seconds).
 - e. (xxx)(yyy)(zzz)(n)OffSp – Off Setpoint (Varies).
 - f. (xxx)(yyy)(zzz)(n)OnDly – On Delay (Seconds).
 - g. (xxx)(yyy)(zzz)(n)OnSp – On Setpoint (Varies).
 - h. (xxx)(yyy)RotCmd – Rotation Command (On/Off).
 - i. (xxx)(yyy)RotSched – Rotation Schedule (Editable Schedule Object).

N. Object Abbreviation Spreadsheet

Term	Abbreviation
Access Denied	AcDn
Access Granted	AcGr
Acidity	Acd
Active	Actv
Actual	Act
Actual Cooling	ActCl
Actual Heating	ActHt
Actuator	Actr
Address	Add
Adjustable, Adjust	Adj
Air	Air
Air Conditioning	AirCond
Air Dryer	AirDry
Air flow measuring station	Afms
Air handling unit	Ahu
Alarm	Alm
Alkalinity	Alk
Alternate	Alt
Alternating current	Ac
Amperage/Current	Amp
Analog Input	AI
Analog Output	AO
Apparent	App
Apparent Power (kVA)	AppPwr
Approach	Aprch
Array Water	Aryw
Arrestor	Arr
Aspirating	Asp
Audio indicator (buzzer)	Audio
Authority	Auth
Automatic	Auto
Automatic Demand Response	Adr
Automatic transfer switch	Ats
Auxilliary	Aux
Average	Avg
Back	Bck
Balance / Balancing	Bal
Baseboard	Bb

Baseline	Base
Battery	Batt
Bias	Bias
Bibb	Bib
Binary Input	BI
Binary Output	BO
Boiler	Blr
Booster	Bstr
Box	Box
Branch	Brnch
Building	Bldg
Building Static Pressure	BldgStPrs
Button	Btn
Buzzer	Buzz
Bypass	Byp
Cabinet	Cab
Calendar	Cldr
Calibration	Cal
Capacity	Cap
Capillary	Cply
Carbon dioxide	Co2
Carbon monoxide	Co
Card	Crd
Caution	Ctn
C-factor	Cfctr
Change/Changeover/Switchover	Chg
Chilled Water	Chw
Chilled Water Entering	ChwEnt
Chilled Water Leavin	ChwLvg
Chilled water return	Chwr
Chilled water supply	Chws
Chiller	Chlr
Circuit	Ckt
Circulation	Circ
City	City
Class	Class
Clear	Clr
Close/closed	Cls
Coefficient	Coeff

Coil	Coil
Cold deck	Cd
Cold deck Temp	CdTmp
Combined	Cmb
Combiner	Comb
Combustion	Cmbs
Command	Cmd
Common	Cmn
Compressor	Cmpr
Computer room air conditioning	Crac
Condensate	Cndst
Condenser	Cnd
Condenser Pan	CdPan
Condenser Water	Cw
Condenser Water Pump	CwPmp
Condenser Water Return	Cwr
Condenser Water Supply	Cws
Conditioning	Cond
Conductivity	Cdv
Constant air volume	Cav
Contact / Contact	Cont
Control	Ctrl
Control variable (loop)	Cv
Controller	Ctlr
Convactor	Conv
Cool Down	CIDn
Cooling	Cl
Cooling coil	Cc
Cooling tower	Ct
Cooling tower fan	CtFan
Coordinated universal time	Utc
Corridor	Corr
Count	Cnt
County	Cnty
Critical	Crit
Current	Cur
Current transformer	CurXfmr
Current Transformer Ratio	CurXfmrRatio
Cycle	Cyc

D Gain	DGain
Damper	Dmpr
Day	Day
Day of month	Dom
Day of week	Dow
Deadband	Db
Deck	Deck
Decrease	Dec
Dehumidify	Dehum
Delay	Dly
Demand	Dmd
Demand Response	DmdRsp
Demand-Controlled Ventilation	Dcv
Depth	Dpth
Detector	Det
Device	Dev
Dew point	Dew
Diesel fuel	Df
Differential	Dif
Differential Pressure	DiffPrs
Direct Acting	DirAct
Direct current	Dc
Direct Expansion (DX)	Dx
Direct Normal	DirNorm
Direct/direction	Dir
Disable	Dsa
Discharge	Dis
Discharge Air	Da
Discharge Air Pressure	DaPrs
Discharge Air Temperature	DaTmp
Display	Disp
Distance	Dist
Diverting	Div
Domestic hot water	Dhw
Domestic hot water return	Dhwr
Domestic hot water supply	Dhws
Domestic water	Dw
Door	Door
Down	Dn

Drawing	Dwg
Drive (Vfd)	Drive
Dry Bulb	DryB
Dual duct	Dd
Duct	Duct
Early (Optimal start-stop)	Erly
East	E
Economizer/Economizing	Econ
Effective	Eff
Effective Cooling	EffCl
Effective Heating	EffHt
Effective Occupancy	EffOcc
Ejection	Eject
Electric	Elec
Electric duct heat/heater/heating	Edh
Electric heat	Eh
Electric preheat	Eph
Electric reheat	Erh
Electric vehicle	Ev
Electric Vehicle Identification	Evid
Electric-to-pneumatic	Ep
Element	Elmt
Emergency	Emer
Emergency Stop Switch	Ess
Enable	Ena
Energy	Enrg
Engine	Eng
Entering	Ent
Entering Water Temp	Ewt
Enthalpy	Enth
Error (loop)	Err
Evaporative	Evap
Exhaust	Exh
Exhaust Air	Ea
Exhaust tracks supply	Ets
Exported	Exp
External/exterior	Ext
Face bypass	Fbyp
Face bypass Damper	FbypDmpr

Factor	Fct
Fail	Fail
Fall (season)	Fall
Fan	Fan
Fan coil unit	Fcu
Fan terminal unit	Ftu
Fast Fan Speed	Fast
Fault	Fault
Feedback	Fdbk
Filter	Flt
Final	Fin
Fire	Fire
Firmware	Frmw
Flame	Flm
Flange	Flg
Float	Float
Floor	Flr
Flow	Flw
Forward	Fwd
Free cooling	Fcl
Free heating	Fht
Freezer	Frz
Frequency	Frq
Frost	Frst
Fuel oil	Fo
Gas	Gas
Gauge	Gauge
Generator	Gen
Global	Glb
Glycol	Gly
Glycol Return	Glyr
Glycol Supply	Glys
Gray water	Gw
Green	Grn
Gross (as opposed to Net)	Grs
Ground	Grd
Group	Grp
Hand	Hand
Hardware	Hrdw

Head	Head
Heat Exchanger	Hx
Heat Pump	Hp
Heat Recovery Unit	Hru
Heat recovery water	Hrw
Heater	Htr
Heating	Ht
Heating coil	Hc
Held Open Too Long	Otl
High	Hi
High End of Reset Scale	RstH
High Head Pressure	HiHeadPrs
High Temp	HiTmp
High Temp Cut Out	Htco
H-O-A/Hand-Off-Auto	Hoa
Hood	Hood
Horizontal	Hor
Hot deck	Hd
Hot deck Temp	HdTmp
Hot Water	Hw
Hot Water Pump	HwPmp
Hot Water Return	Hwr
Hot Water Supply	Hws
Humidity/Humidifier	Hum
Ice storage	Ice
Identification	Id
Ignore	Ign
Increase	Inc
Increment	Inct
Index	Index
Indirect	Ind
Indoor air quality	Iaq
Indoor environmental quality	Ieq
Induction	Induct
Infectious	Inf
Initial	Init
Inlet	Inlet
Inlet guide vanes	Igv
Input	In

Instance	Inst
Integral gain (loop)	IGain
Interstage	Int
Interval	Intv
Invalid	Invd
Inverter	Inv
Irradiance	Irrad
Irrigation	Irrg
Irrigation water	Irrgw
Isolation	Iso
K-factor	Kfctr
Lag	Lag
Lap	Lap
Last	Last
Late	Late
Lead	Lead
Leaving	Lvg
Leaving Water Temp	Lwt
LEED (for energy efficiency)	Leed
Leisure	Lsr
Length	Lgth
Level	Lvl
Limit	Lmt
Line (electrical)	Ln
Line-line (electrical)	LnLn
Line-neutral (electrical)	LnNeut
Link	Lnk
Liquid	Liq
Local	Local
Local time clock	Ltc
Lock	Lck
Lockout	Lckout
Loop	Lp
Louver	Lvr
Low	Lo
Low temp Cut out	LoTmpCo
Main	Main
Make up water	Muw
Make-up	Mu

Manifold	Mf
Manual	Man
Manufacturer	Mfr
Maximum	Max
Maximum Position	MaxPos
Media access control	Mac
Medium	Med
Meter	Meter
Minimum	Min
Minimum On Time	MinOnTm
Minimum Position	MinPos
Miscellaneous	Misc
Mixed Air	Ma
Mixed Air Temp	MaTmp
Mixing	Mix
Mode	Mode
Mode (mathematical)	Mmod
Model	Model
Modulation, Modulating	Mod
Morning cool down	Mcdn
Morning Warm-Up	Mwup
Motor	Mtr
Multi zone	Mz
Multi/multiple	Multi
Negative	Neg
Net (as opposed to Gross)	Nt
Network	Net
Neutral (electrical)	Neut
Next	Next
Night	Nght
Normal	Norm
Normally Closed	NormClsd
Normally Open	NormOpn
North	N
Notification	Ntfcn
Occupied	Occ
Occupied Cooling	OccCl
Occupied Heating	OccHt
Off	Off

Offset	Offst
Oil	Oil
On	On
One	One
Open	Opn
Operator	Oper
Optimal start stop	Oss
Optimized	Opt
Out	Out
Outside Air	Oa
Outside Air Damper	OaDmpr
Over	Ov
Overload	OI
Override	Ovrd
Overtime	Ovt
Oxidation reduction potential	Orp
P Gain	PGain
Pan	Pan
Panel	Pnl
Parallel	Par
Parallel fan terminal unit	Pftu
Peak	Peak
Performance	Perf
Persistent	Prst
Phase	Phs
Phase A	Phsa
Phase B	Phsb
Phase C	Phsc
Phase Reversal	PhsRev
Photovoltaic	Pv
PID (loop)	Pid
Pilot	Plt
Plane of array	Poa
Plant	Plnt
Pneumatic	Pneu
Pool	Pool
Position	Pos
Positive	Posv
Power	Pwr

Power distribution unit	Pdu
Power Factor	PwrFct
Power Induction Unit	PwrInductUnit
Pre	Pre
Precipitation	Precip
Pressure	Prs
Pressure Differential	PrsDif
Previous	Prev
Primary	Pri
Primary Chilled Water	PriChw
Priority	Priority
Process variable (loop)	Procv
Processor board	Pcb
Proportional	Prop
Protective	Prot
Protective (medical isolation)	Pro
Pulse, Pulses	Pls
Pump	Pmp
Radiant	Rad
Ramp	Rmp
Range	Rng
Rate	Rate
Ratio	Ratio
Reactive (electrical)	Rct
Real (electrical)	Real
Real Power (kW)	RelPwr
Received	Rcvd
Recool	Rcl
Recovery, Recovered	Rcv
Reduction	Red
Reference	Ref
Refrigerant	Rfg
Regenerate/-d/-ing	Rgn
Reheat	Rh
Reheat coil	Rhc
Rejected	Rejct
Rejection, Rejected	Rej
Relative Humidity (%)	RelHum
Relay	Rly

Relief	Rlf
Relinquish	RIq
Remaining	Rmg
Remote	Rmt
Repeater	Rptr
Request	Req
Reset	Rst
Respond	Resp
Return	Ret
Return Air	Ra
Return Air Fan	RaFan
Reverse Acting	RevAct
Reverse/reversal	Rev
Roof top air handling unit	Rtu
Room	Rm
Rotate	Rot
Router	Rtr
Run	Rn
Run Time (hours)	RnTm
Sash	Sash
Schedule	Sched
Season/Seasonal	Season
Secondary	Sec
Secondary Chilled Water	SecChw
Select/selector/selection	Sel
Sensor	Snsr
Sequence	Seq
Serial Number	Serial
Series	Ser
Series fan terminal unit	Sftu
Service	Svc
Setpoint	Sp
Short	Short
Short Cycle	ShortCyc
Shoulder (season)	Shldr
Shutdown	Shutdn
Single duct	Sd
Slow	Slw
Slow Fan Speed	Slow

Smoke	Smk
Snow , Snow-melt	Snw
Snowmelt	Snwmlt
Software	Sftw
Solar	Sol
Solar thermal water return	Stwr
Solar thermal water supply	Stws
Source	Src
South	S
Speed	Spd
Spring (season)	Sprg
Stage	Stg
Standard	Std
Standby	Stby
Start	Strt
Static (pressure)	St
Status	Sts
Step	Step
Stop	Stp
Storage	Stor
Strainer	Str
Suction	Sct
Summer	Sumr
Sump	Sump
Superheat	Spht
Supply	Sup
Supply air	Sa
Supply air fan	SaFan
Switch	Sw
Switchgear	Swgear
System	Sys
Tamper	Tmpr
Tank	Tnk
Target	Tgt
Temperature	Tmp
Tempered water	Tw
Tempered water return	Twr
Tempered water supply	Tws
Temporary	Temp

Temporary Occupancy	TempOcc
Temporary Override	TempOvrd
Terminal unit	Tu
Thermal energy	Therm
Thermal Overload	ThermOl
Third	Third
Time	Tm
Time of day	Tod
Timer	Tmr
Ton	Ton
Total	Tot
Total harmonic distortion	Thd
Tracking	Trk
Transducer	Xdcr
Transformer	Xfmr
Trend (History)	Td
Trim	Trm
Trip	Trp
Turbidity	Turb
Two	Two
Type	Type
Ultraviolet	Uv
Unbalanced	Unbal
Under	Un
Under Floor Static Pressure	UnFlrStPrs
Underwriters Laboratories	UI
Uninterruptible Power Supply	Ups
Unit	Unit
Unit Heater	UnitHtr
Unit ventilator	UnitVent
Unix system	Unix
Unlocked	Unlkd
Unoccupied	Unocc
Up	Up
User	Usr
Utility	Util
Valid	Vld
Value	Val
Valve	Vlv

Vane	Vane
Variable	Var
Variable air volume	Vav
Variable frequency drive	Vfd
Variable refrigerant volume	Vrv
Variable volume & temperature	Vvt
Velocity	Vel
Ventilation	Vent
Version	Ver
Vibration	Vib
Virtual	Vrt
Volatile organic compounds	Voc
Volt amperes	Va
Voltage	Vlt
Volumetric	Vol
Warm Up	WarmUp
Warm/Cool	WmCl
Warning	Warn
Water	Wtr
Water Source Heat Pump	WtrSrcHtPmp
Water treatment system	Wts
Water Under Floor	WtrUnFlr
Weekday	Wkdy
Weekend	Wknd
Well	Well
West	W
Wet bulb	Wb
Wheel (energy wheel)	Whl
Wind	Wind
Winter (season)	Wint
Wireless	Wrls
Zone	Zn

END OF SECTION

APPENDIX B – GRAPHICAL STANDARD FOR NIAGARA N4

1.1 GENERAL INFORMATION

- A. Graphics will be created and stored on the SRP supervisor utilizing graphical standards outlined in this document.
- B. Graphics will be organized into the file structures, as outlined in this standard.
- C. Controllers will be organized into a standardized folder structure, as outlined in this standard.
- D. Graphics will be rendered as N4 HTML 5 views. Any graphic pages that in any way depend on browser-side-applets are not permitted.
- E. Static images are permitted on ductwork and piping only. All other graphical representations must be animated wherever possible
- F. Proxy point naming will remain unchanged. The graphic bindings will be updated to match the proxy point names
- G. Any hyperlinks outside of the SRP firewall are prohibited from being added to any Niagara graphics
- H. Vendor names, logos, or other vendor identification or promotion are not permitted on the graphics
- I. Creating new folders or alteration of any of the files in the SRP_Standards folder is prohibited
- J. Objects, graphics, and anything needed to create new graphics using this Standard Implementation Guide will be available on the SRP Niagara N4 supervisor

1.2 STANDARD GRAPHIC LAYOUT

- A. Graphics are defined as equipment graphics, summary graphics, popup graphics, or navigation graphics. Graphic types are described below.

1. Equipment Graphics:

- a. Equipment graphics consist of a standard background size, px includes for a header and footer graphics, and a main graphic. The standard backgrounds are located under SRP_Standards > Backgrounds.



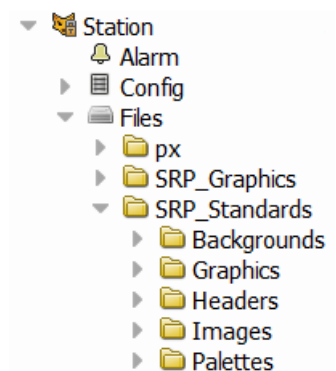
2. Summary Graphics:
 - a. Summary graphics consist of a standard background size, and px includes for a header and footer graphic. These will include either a floorplan graphic or px includes with definable variables for equipment summaries. Summary graphics will include all applicable equipment required for the summary graphics as detailed in the Main Graphic Specifications section. If all the information does not fit on a single summary graphic, navigation buttons will be included for ease of navigation between the different graphics.
3. Navigation Graphics:
 - a. Navigation graphics consist of the navigation background under SRP_Standards. This consists of px includes for the building specific header and footer graphics only. Home pages are considered navigation pages, and requirements for these are detailed in the Main Graphic Specifications section. Other navigation pages will be specified by SRP.
4. Popup Graphics:
 - a. Popup graphics are for additional information not on the main graphics. Standard popup graphics are in SRP_Standards. Acceptable types of information used for popup graphics as detailed in the Main Graphic Specifications section. A template background for popup graphics can be found in SRP_Standards > Background for any new popups not available in the standards. Unlike other graphics, the size of this canvas is relative to the information contained and does not require any px includes.
 - b. The Popup Graphics are hyperlinked to corresponding main graphics with a Popup Binding. The button for the Popup binding can be found in the standard palettes. The size of the popup window will be set to 50 pixels more on both the height and width of the corresponding popup graphic canvas size to allow for the window frame.

1.3 LOCATING STANDARD GRAPHICS

- A. All standard graphics including px pages, images, and tools will be organized in the Niagara N4 file structure under SRP_Standards.

- B. The standards file structure is illustrated as follows:

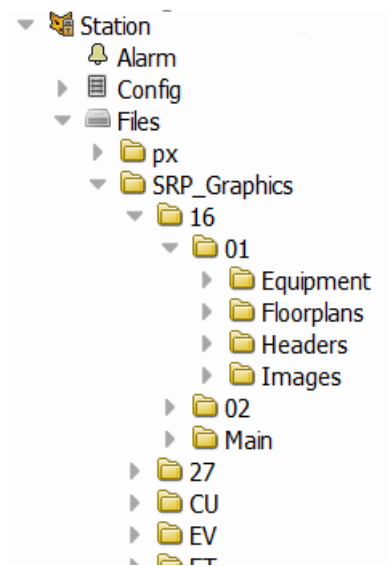
1. Backgrounds – Consists of folders for equipment template backgrounds, graphic backgrounds for px includes, and navigation backgrounds configured in the approved sizes.
2. Graphics – Consists of all approved standard graphic px includes, organized into subfolders by system/equipment types. System/equipment specific headers, footers, and popups will be in the graphics folder in their respective subfolders.
3. Headers – Consists of the standard headers formatted and sized to match background sizes.
4. Footers – Consists of the standard footers formatted and sized to match background sizes.



5. Images – Consists of all the standard, non-building specific image files used in any of the standard graphics, headers, buttons, etc. Building specific images will be saved under their respective Active Graphic File.
6. Palettes – Consists of all the standard palettes with the pre-formatted points, buttons, objects, etc. as outlined in this graphic standard.

1.4 ACTIVE GRAPHIC FILE LOCATIONS

- A. All graphics being used for live devices on the Niagara N4 supervisor are classified as active graphics. Active graphics and all corresponding images, navigation files, etc. will be organized and stored in the SRP_Graphics folder.
- B. Each site has its own folder depicted by the two-digit abbreviation code. In each site folder, there is a Main folder for all site specific and non-building specific graphics (Example includes site home page). Each site folder will also include a folder for each building on that site, depicted by a two-digit number.
- C. Any graphics, images, or other files that are not active due to controllers being removed or newer graphics being used, are to be removed.
- D. The standardized organization of each individual building file structure is illustrated as follows:
 1. Equipment – All graphics, unless stated otherwise, will be organized in this folder. This folder will also include all equipment specific documents, charts, etc. Each equipment with unique graphics will have a folder matching the equipment name. For equipment that share a multiple graphic, a folder will be created referencing the equipment type. See details for naming in the Main Graphic Specification section.
 2. Floorplans – Floorplan graphics, as outlined in this standard, will be organized into the Floorplans folder.
 3. Headers – Every building will have a pre-formatted set of headers. These headers will be stored in this Headers folder.
 4. Images – All images used in a specific building, which are not part of a palette will be stored in the Images folder. This folder also includes a Floorplans subfolder that will include all the approved and pre-formatted floorplan image files for the building.



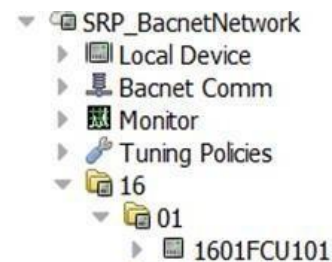
1.5 NIAGARA DEVICES

- A. All JACEs will be mapped into the Niagara N4 Supervisor. This will be for JACE communication alarming and backups ONLY. No points, trends, alarms, etc. will be mapped as Niagara points from the JACEs into the supervisor.

- B. JACEs will be organized in the Niagara Driver folder by site and by building with folder structures and naming following the same standard as laid out in the BACnet Controllers section.

1.6 BACNET DEVICES

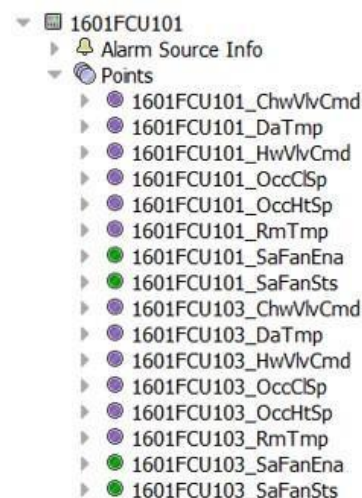
- A. Under the BACnet Network driver will be a folder for each site depicted by the site two-character abbreviation code. Each site folder will also include subfolders for each building located on that site, depicted a two-digit building number.
- B. Devices will be organized in their corresponding building subfolder. The device name will remain unchanged from discovery unless otherwise specified by SRP.



1.7 BACNET POINTS

- A. All points will be proxied from the device directly into the points folder under the corresponding device.
- B. The BACnet points will then be manipulated and organized as follows:
 1. Each system/equipment referenced in the proxied point names will require a BACnet points folder that matches their corresponding system/equipment names. This is true even if there is only one system.
 2. The points will be organized into their corresponding equipment folder. All points will be moved, not copied, from the root points folder.
 3. Once points are organized in their respective system or equipment folders, the site/building/equipment identifier will be removed from the proxied name.
 4. Graphics for the system/equipment will be mapped to the BACnet point folders as specified in the Implementing a Standard Graphic section.

BEFORE



AFTER



1.8 BACNET NOTIFICATIONS

- A. BACnet notifications will be proxied through the device Alarms folder. Each device will be configured to route the alarms to the site and building default class (Example 1610_Default). See more information on alarming and additional alarm requirements in the Niagara Alarming section.

1.9 BACNET TRENDING

- A. All trending will be mapped over as BACnet trend objects from the BACnet devices directly. Trending will be set to import every (1) hour from the field devices into the Niagara platform. Trending storage for Niagara JACEs will be limited to (2) two weeks of data before rollover will occur. Trending for the Niagara Supervisor platforms will be unlimited.
- B. Unless pre-approved by SRP, no trending will be created as Niagara trend objects, and notrends will be mapped between Niagara platforms.

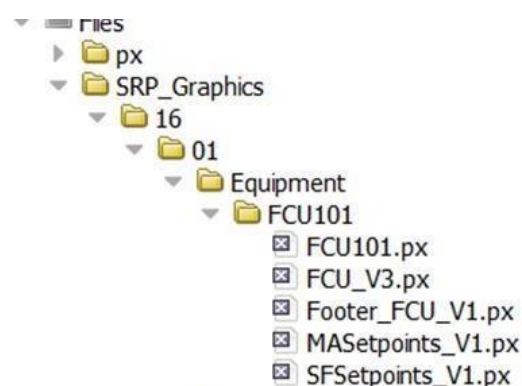
1.10 BACNET SCHEDULES

- A. All schedules will be mapped over as BACnet schedule objects from the BACnet controller directly. See more information on scheduling and additional schedule requirements in the Niagara Schedules section.

1.11 IMPLEMENTING STANDARD GRAPHICS

A. Create Graphic Folder:

1. In SRP_Graphics, locate the Equipment folder under the Site/Building and create a folder with the same name as the equipment (Example AHU3). Any graphics or documents relevant to this equipment will be organized in this new folder.
2. For equipment that shares graphics, reference the Main Graphic Specifications section on folder naming.



B. Using Equipment Graphic Standard:

1. Look in the SRP_Standards folder for an existing graphic that closely resembles the equipment or system configuration.
 - a. Graphics are organized by system type
 - b. In each system type folder (e.g., Air Handling Units > Multi Deck Units), reference the Summary.txt file(s) for a summary of the system configuration for each px file.

```

Air Handling Unit Dual Duct Graphics
AHUDD_V1 - Return and exhaust duct with exhaust damper controlled by outside air damper
AHUDD_V2 - Return and exhaust duct with exhaust damper controlled by outside air damper
AHUDD_V3 - Return duct only, no exhaust
AHUDD_V4 - Return duct only, no exhaust, and return air controlled with damper

Air Handling Unit Triple Duct Graphics
AHUM3_V1 - Return duct only, no exhaust
  
```

2. Copy the selected equipment standard graphic for the main graphic to the equipment folder created in SRP_Graphics. Do not rename this file.
3. After identifying the size of the main graphic, select the corresponding background graphic size from the SRP_Standards Background folder and copy it to the new

equipment folder. Rename the background graphic to match the equipment (folder) name.

4. Copy all relevant footers and popups necessary for the graphic into the equipment folder created in SRP_Graphics.
5. Points or images not required on the graphic for this specific equipment type can be deleted in the copied graphics. Nothing will be deleted or changed in the versions stored in SRP_Standards.
6. New sensors, points, links, etc. can be added as needed to the copied graphic, as necessary.
7. New graphic standards are required when the system does not exist, or there is a significant difference in equipment, piping, etc. from the closest existing standard drawing. All new graphic standards are to be created by or pre-approved for creation and use by SRP.

1.12 GRAPHIC FOLDER MAPPING

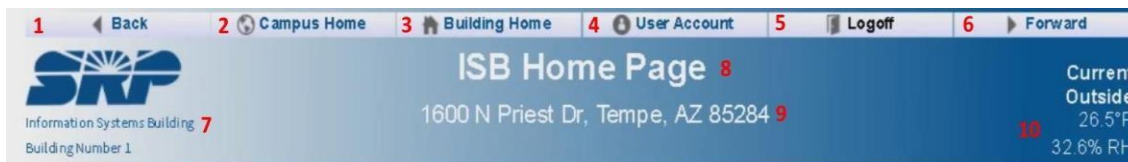
A. All graphics for BACnet controllers will be mapped to a folder as follows:

1. Equipment specific graphics controlled predominantly by a single device will be mapped to the folder matching the device name under points. See the BACnet Devices section for folder references.
2. Equipment controlled by multiple devices will be mapped to a folder created under the building folder in the BACnet network folder. See the Main Graphics Specification section for more detail on folder naming and mapping.
3. All folders with graphic mappings utilizing a px include header will require the addition of two slots (Title and Description) for the header graphic. All points in the graphic will be relativized after the appropriate graphic is applied to the folder.

Slot Sheet						
Slot	#	Name	Display Name	Definition	Flags	Type
☐ Property	0	AHUSummary	AHUSummary	Dynamic	o	baja:PxView
☐ Property	1	Title	Title	Dynamic		baja:String
☐ Property	2	Description	Description	Dynamic		baja:String

1.13 GRAPHIC HEADER

A. Each main graphic requires a header matching the size of the background graphic canvas. Each building has pre-configured headers (Small, medium, and large) that can be found in the SRP_Graphics file folder structure in the Headers folder.



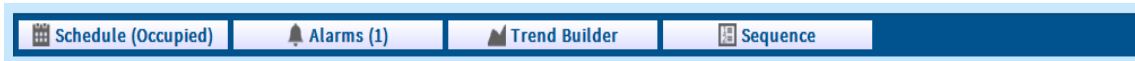
B. Button description and actions are as follows (All links are completed with bajaui:Value Binding):

1. Preconfigured BackButton from the kitPx palette

2. Campus Home button with a link to the Home.px main campus page
3. Building Home button to be linked to the homepage for the building, different on every set of header templates.
4. Link to the user accounts page to edit user parameters based on user security level.
5. Preconfigured LogoffButton from the kitPx palette.
6. Preconfigured ForwardButton from the kitPx palette.
7. The unbound text fields set up on BoundLabel objects. The top text field is used for the site identifier and the bottom text field is used for the building identifier.
8. A BoundLabel object with ord set to the slot:Title.
9. A BoundLabel object with ord set to the slot:Description.
10. A set of BoundLabels. These will have the kitPx:Bound Label Binding properties ord set to the sensed values of a local weather station attached to the building or located on site. If a local weather station is unreliable, a reading may be obtained via weather application native to Niagara that will allow you to obtain weather data uploaded from other local weather stations. The top text box is the current temperature, and the bottom text box is the current humidity.

1.14 GRAPHIC FOOTERS

- A. Graphic footers are required whenever additional links are needed outside of the hyperlinks/actions available in the header, and the links on the graphic specific to the graphic contents.



- B. Pre-built footers are included in SRP_Standards. However, if any changes are necessary, all preconfigured buttons/links (listed here) are available in standards palette and on graphic templates. Examples included are as follows:
1. Schedule – Link to the schedule, no special graphic, just the schedule itself
 2. Alarms – Link to the alarm module for the lowest level available (Equipment level if available, then building level)
 3. Trend Builder – Link to trends folder for equipment, see more information in the Trending section.
 4. Sequence – Link to a PDF of the equipment sequence of operation saved on the Niagara N4 supervisor
 5. Link to Parent Graphic – Link to the parent graphic, as stated in the Main Graphic Specifications section.

1.15 GRAPHIC LINKS

- A. All active graphics for systems/equipment will have required links to equipment, setpoints, and trends on the graphic, which are not included in the header or footer. These are defined in the Main Graphic Specifications section, and are depicted as follows:

1. All pre-built charts are to be linked to the corresponding graphic with the pre-configured chart button. 
2. All equipment detail graphics (e.g., equipment communication card, VFD) are to be linked with the pre-configured information 
3. All additional graphical setpoints are to be linked to the graphic is a popup setpoints link button. 

1.16 GRAPHIC IMAGES

- A. All active graphics must be generated using one of the following palettes:
 1. kitPxGraphics.
 2. webChart.
 3. Bajau.
- B. If additional pallets are desired for graphical generation, they must be approved SRP prior to implementation.
- C. All images from any graphic module must remain in the default px folder in the file structure. This folder is prohibited from being altered in any way.
- D. All palette images Value Binding properties, unless otherwise noted, must be set as follows:
 1. hyperlink to null.
 2. summary to null.
 3. popupEnable to false.
- E. All images not from a palette must be in an Image object and are not permitted to be in a Label object.
- F. All images must be saved in the proper image folder in the file structure as follows:
 1. Images used in template headers or backgrounds will be stored in the SRP_Standards Images folder.
 2. Main navigation graphic images for site navigation graphics will be stored in the SRP_Graphics site specific Main Images folder
 3. Building specific graphics will be stored in the SRP_Graphics building specific Main Images folder
- G. All images must be formatted to a size matching the Picture object and must have the scale set to None. Scaling of images is notpermitted.

1.17 GRAPHIC POINTS AND LABELS

- A. All graphical points and labels will need to be configured to match the SRP Point Naming Standards. All pre-formatted labels and points are available in the standard palettes on the SRP Niagara Supervisor. All hardwired, controlled setpoints, and alarms will be

visible on main graphics. All other points, including lockout points, configuration points, and detailed alarms, will be available on popup graphics.

- B. There are three different label options for main graphics (Not including headers) as follows:
1. Points Label – Used for all point name labeling.
 2. Equipment Label – For sub equipment labeling.
 3. Table Label – Headers for all table data in summary graphics.
- C. There are three different bound label options as follows:
1. Write Points – For all points that have a set or an override option.
 2. Read Points – For all points that do not have a set or an override option.
- D. All points will be configured as followed:
1. Writeable points that are intended for override only will have the SET action flag hidden.
 2. All writable points will have their Emergency Override and Emergency Auto action flags hidden.
 3. All writable points will have a facet to limit the max override time to (8) hours.
 4. All points that have an available trend will have the points hyperlink property set to the corresponding trend.
- E. Numeric points, if not already configured in the controller, will have the units and precisions set to the following standards:

Category	Engineering Unit	Abbrev	Precision
Electrical Voltage	Alternating Current Volts	VAC	0.1
Electrical Current	Amperes	A	0.1
Thermal Energy	British Thermal Unit	BTU	0.1
Natural Gas Volume	Therms	THERM	0.1
Air Flow Volume	Cubic Feet per Minute	cfm	1
Electrical Voltage	Direct Current Volts	VDC	0.1
Temperature	Fahrenheit	°F	0.1
Air Flow Velocity	Feet per minute	fpn	0.1
Water Volume	Gallons	Gal	1
Electrical Power (Real)	Gigawatt	GW	1
Time	Hours	h	0.1
Natural Gas Volume	Hundred Cubic Feet	CCF	1
Air Pressure	Inches of Water Column	inWC	0.01
Air Pressure Differential	Inches of Water Column	inWCD	0.01
Electrical Energy (Apparent)	Kilovolt-ampere-hour	kVAh	1
Electrical Power (Apparent)	Kilovolt-amperes	kVA	1
Electrical Power (Real)	Kilowatt	kW	1
Electrical Energy (Real)	Kilowatt-hour	kWh	1

Electrical Power (Real)	Megawatt	MW	1
Electrical Current	Milliamps	mA	0.1
Thermal Energy	Million BTU	MMBTU	1
Electrical Voltage	Millivolts	mV	0.1
Time	Minutes	m	0.1
Electrical Energy (Real)	MW-hour	MWh	1
Carbon Dioxide (CO2)	Parts per Million	ppm	1
Carbon Monoxide (CO)	Parts per Million	ppm	1
Volatile Organic Compound (VOC)	Parts per Million	ppm	1
Relative Humidity	Percentage	%	0.1
Modulating Command / Feedback	Percentage (Open/Closed)	%	1
Water Pressure	Pounds per Square Inch	psiG	0.1
Water Pressure Differential	Pounds per Square Inch Differential	psiD	0.1
Time	Seconds	s	1
Thermal Energy	Thousand BTU	MBTU	1
Natural Gas Volume	Thousand Cubic Feet	MCF	1
Thermal Energy	Tons of Cooling	Tons	0.1
Electrical Energy (Apparent)	Volt-ampere-hour	Vah	0.1
Electrical Power (Apparent)	Volt-amperes	VA	0.1
Electrical Power (Real)	Watt	W	0.1
Electrical Energy (Real)	Watt-hour	Wh	0.1

F. Boolean points, if not already configured in the controller, will have the following TRUE/FALSE values:

1. Enable – Enable/Disable.
2. Alarm – Alarm / Normal.
3. Status (With exceptions to actuators) – On/Off.
4. Actuator Status – Open/Closed.
5. Reset – Reset/Off.

1.18 NIAGARA ALARMING

- A. Each site and building will be pre-configured for each of the alarm classes (Default, Critical, and Emergency) and the alarms will be routed accordingly. There will be a general alarm console for all alarms across all SRP sites. Additional alarm consoles will be added for each site and building, and will named after each site and building (Ex. 27_Alarms and 2701_Alarms). These site and building specific alarm consoles will be bound to the alarms link button on each graphic footer.
- B. Each building and site will also have a total number of alarms counted for both the default and critical alarms linked to a numeric point for each building footer to depict the total number of active alarms (Ex 2701_AlmCnt).
- C. Alarms will be organized into two classes per building.

- D. Critical and Emergency Alarms:
 - 1. Niagara alarm objects will be created for alarms that are classified by SRP as Critical or Emergency. These may be duplicate alarms to the default alarms.
 - 2. Each created alarm will have the alarm class configured to match the correct site, building, and critical class.
 - 3. See Division 23, Section 23 09 93 for required alarms.

1.19 NIAGARA SCHEDULES

- A. All main graphics, floorplans, alarm consoles, trends, charts, and documents will be included in a nav file.
- B. The naming and the organization of the navigation tree is laid out in the Main Graphics Specification sections. The icons for the navigation tree will reflect the example navigation tree in the graphic standards.
- C. Under each graphic component in the navigation tree, include the following components where applicable and if the components exist:
 - 1. Trends – Linked to a blank trend builder, and under include all the corresponding equipment trends linked to a trend builder.
 - 2. Charts – Linked to a blank trend builder, and under include all the pre-configured charts for the corresponding equipment.
 - 3. Schedule – Linked to the schedule for the corresponding equipment.
 - 4. Sequence – Linked to the PDF of the sequence for the corresponding equipment.

1.20 MAIN GRAPHIC SPECIFICATIONS

- A. Each of the following graphics in this section and the Detail Graphics Specifications section has the following information:
 - 1. Navigation Tree Configuration - How the equipment will be referenced in a navigation tree file
 - 2. Popup Graphics – Required popup graphic buttons.
 - 3. Graphic Links – Required links on the equipment page to other main graphics.
- B. Air Compressor:
 - 1. Navigation Tree Configuration - In root of building nav file with component named Air Compressor.
 - 2. Popup Graphics – No popup graphics for this equipment.
 - 3. Graphic Links - Graphic will not require any links.
- C. Air handling Unit – Fan Coil Units:
 - 1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
 - 2. Popup Graphics – Supply Air Temperature Reset, Optimized Configurations, Mode Lockouts.
 - 3. Graphic Links – As follows:

- a. Link to hot water plant or building heat exchanger if hot water coil.
 - b. Link to steam boiler plant if steam coil.
 - c. Link to chilled water plant if chilled water coil.
 - d. Link to air compressor if pneumatic controls.
 - e. Link to any VFD information graphics.
- D. Air handling Unit – Outside Air Units:
 1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
 2. Popup Graphics – Supply Air Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts, Recovery Setpoints.
 3. Graphic Links – As follows:
 - a. Link to zone summary page (if multi-zone).
 - b. Link to recovery unit if separate graphic.
 - c. Link to hot water plant or building heat exchanger if hot water coil.
 - d. Link to steam boiler plant if steam coil.
 - e. Link to chilled water plant if chilled water coil.
 - f. Link to air compressor if pneumatic controls.
 - g. Link to any VFD information graphics.
- E. Air handling Unit – Multi Deck Units:
 1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
 2. Popup Graphics – Hot Deck Temperature Reset, Cold Deck Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts.
 3. Graphic Links – As follows:
 4. Link to any other units controlling space in addition to current unit.
 5. Link to zone summary page.
 6. Link to hot water plant or building heat exchanger if hot water coil.
 7. Link to steam boiler plant if steam coil.
 8. Link to chilled water plant if chilled water coil.
 9. Link to air compressor if pneumatic controls.
 10. Link to any VFD information graphics.
- F. Air handling Unit – Multi Zone Units:
 1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
 2. Popup Graphics – Hot Deck Temperature Reset, Cold Deck Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts.
 3. Graphic Links – As follows:
 4. Link to zone summary page.
 5. Link to hot water plant or building heat exchanger if hot water coil.
 6. Link to steam boiler plant if steam coil.
 7. Link to chilled water plant if chilled water coil.
 8. Link to air compressor if pneumatic controls.

9. Link to any VFD information graphics.
- G. Air handling Unit – Single Zone Units:
1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
 2. Popup Graphics – Supply Air Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts.
 3. Graphic Links – As follows:
 4. Link to zone summary page.
 5. Link to hot water plant or building heat exchanger if hot water coil.
 6. Link to steam boiler plant if steam coil.
 7. Link to chilled water plant if chilled water coil.
 8. Link to air compressor if pneumatic controls.
 9. Link to any VFD information graphics.
- H. Boiler Summary Graphic:
1. Navigation Tree Configuration - In Hot Water System component with component matching Boiler name (Example Boiler 1).
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 4. Link to hot water system / steam boiler plant graphic (Footer Link).
- I. Building Hot Water Circulation Graphic:
1. Navigation Tree Configuration - In Hot Water System component with component named Circulation Pumps.
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 - a. Link to hot water system / steam boiler plant graphic (Footer Link).
 - b. Link to any VFD information graphics.
- J. Building Heat Exchangers:
1. Navigation Tree Configuration - In root of building nav file with component named Building Heat Exchanger.
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 - a. Link to feeding hot water system / steam boiler plant graphic.
 - b. Link to feeding chilled water system
 - c. Link to circulation pumps.
 - d. Link to any VFD information graphics.
- K. Chilled Water Plant:
1. Navigation Tree Configuration - In root of building nav file with component named Chilled Water System.
 2. Popup Graphics – System Enable Setpoints, Chilled Water Setpoint Reset, Chilled Water Pressure Reset, Lead/Lag Settings.

3. Graphic Links – As follows:
 4. Link to cooling tower graphic.
 5. Link to any VFD information graphics.
 6. Link to air compressor if pneumatic controls.
- L. Chiller Summary Graphic:
1. Navigation Tree Configuration - In Hot Water System component with component matching Chiller name (Example Chiller 1).
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 - a. Link to chilled water plant (Footer Link).
- M. Cooling Tower(s):
1. Navigation Tree Configuration - In Chilled Water System component with component named Cooling Towers.
 2. Popup Graphics – System Enable Setpoints, Chilled Water Setpoint Reset, Chilled Water Pressure Reset, Lead/Lag Settings.
 3. Graphic Links – As follows:
 - a. Link to chilled water system graphic (Footer Link).
 - i. Link to any VFD information graphics.
- N. CRAC Units:
1. Navigation Tree Configuration - In root of building nav file with component named CRAC Units.
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 - a. Link to floorplan.
- O. Deionized Water System:
1. Navigation Tree Configuration - In root of building nav file with component named Deionized Water System.
 2. Popup Graphics – None required.
 3. Graphic Links – None required.
- P. Domestic Water Systems:
1. Navigation Tree Configuration - In root of building nav file with component named Domestic Water System.
 2. Popup Graphics – None required.
 3. Graphic Links – None required.
- Q. Emergency Generator:
1. Navigation Tree Configuration - In root of building nav file with component named Emergency Generator.
 2. Popup Graphics – None required.
 3. Graphic Links – None required.

R. Exhaust Fans:

1. Navigation Tree Configuration - In Exhaust Fans component with component named matching exhaust fan name (ex EF01).
2. Popup Graphics – None required.
3. Graphic Links - None required.

S. Fan Coil Unit:

1. Navigation Tree Configuration - In FCU Summary component with component matching FCU name.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
 - a. Link to hot water plant or building heat exchanger if hot water coil.
 - b. Link to chilled water plant if chilled water coil.
 - c. Link to air compressor if pneumatic controls.

T. Fan Powered Box:

1. Navigation Tree Configuration - Under serving air handling unit component under Terminal Unit Summary component with component matching FPB name.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
 - a. Link to serving air handling unit (Footer Link).
 - b. Link to hot water plant or building heat exchanger if hot water coil.
 - c. Link to air compressor if pneumatic controls.

U. Lab Systems:

1. Navigation Tree Configuration - In root of building nav file with component named Lab System Summary.
2. Popup Graphics – None required.
3. Graphic Links – None required.

V. Solar Systems:

1. Navigation Tree Configuration - In root of building nav file with component named Solar System.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
4. Link to Utilities graphic.

W. Unit Vents:

1. Navigation Tree Configuration - In Unit Vent Summary component with component matching unit Vent name.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
4. Link to hot water plant or building heat exchanger if hot water coil.

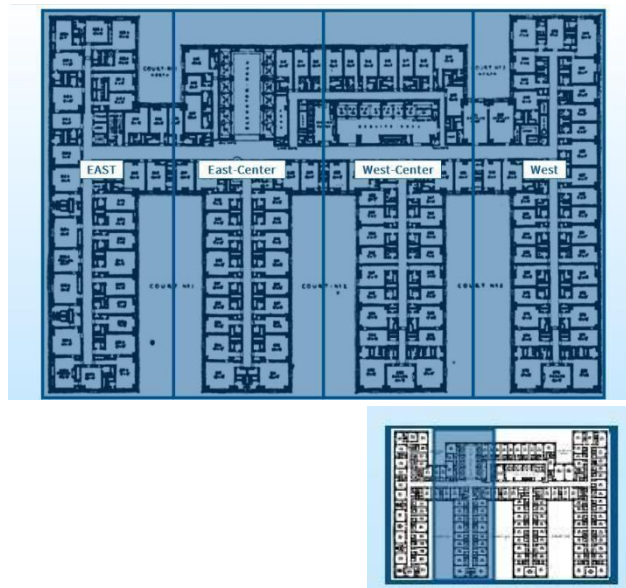
X. VAV Terminal Unit:

1. Navigation Tree Configuration - Under serving air handling unit component under Terminal Unit Summary component with component matching VAV name.
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 - a. Link to serving air handling unit (Footer Link).
 - b. Link to hot water plant or building heat exchanger if hot water coil.
 - c. Link to air compressor if pneumatic controls.
- Y. VFD Summary:
1. Navigation Tree Configuration - Under system component VFD serves in VFD component with component matching VFD name (Ex CHWP1).
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 - a. Link to system graphic for the system the VFD serves (Footer Link).
- Z. Window Controls:
1. Navigation Tree Configuration - In root of building nav file with component named Window Control.
 2. Popup Graphics – None required
 3. Graphic Links – None required
- AA. Zone:
1. Navigation Tree Configuration - Under serving air handling unit component under Terminal Unit Summary component with component matching Zone name (Zone 1).
 2. Popup Graphics – None required.
 3. Graphic Links – As follows:
 - a. Link to serving air handling unit (Footer Link).
 - b. Link to hot water plant or building heat exchanger if hot water coil.
 - c. Link to chilled water plant if chilled water coil.
 - d. Link to air compressor if pneumatic controls.
- 1.21 DETAIL GRAPHIC SPECIFICATIONS:
- A. The detail graphic specifications include main building pages, floorplans, and summary graphics. For each of these graphics, reference the standard graphics and standards palette for formatting of shapes, labels, and points.
- B. AHU Summary Graphics:
1. Includes all air handling units in a specific building. The information included in an AHU summary graphics (if available) is as follows:
 - a. Name of AHU (Ord to graphic Slot:displayName) with hyperlink to graphic.
 - b. Area served (Ord to graphic Slot:Description) with hyperlink to Floorplan.
 - c. Occupancy (Ord to active occupancy point) with hyperlink to schedule.
 - d. Supply Fan Status
 - e. Space temperature

- i. If multiple zones are served, the average of all space temperatures will be represented.
 - f. Discharge air temperature or Supply air temperature
 - g. Static Pressure
 - h. Alarm Status
 - i. Terminal unit summary button – Add if AHU Terminal summary exists and link to that graphic.
 - 2. Graphic location specifications as follows:
 - a. PX Location – Graphic on AHUSummary folder
 - b. Navigation Tree Configuration - In root of building nav file with component named AHU Summary.
- C. AHU Terminal Summary:
- 1. Includes all the terminal units for any air handling unit with multiple zones or terminal devices. The information included in an AHU Terminal Summary graphics (if available) is as follows:
 - a. Name of Terminal Units (Ord to graphic Slot:displayName) with hyperlink to graphic.
 - b. Area served (Ord to graphic Slot:Description)
 - c. Occupancy (If space has separate occupancy from unit).
 - d. Space temperature
 - e. Active space temperature setpoint
 - f. Heat Stage Command or Hot Water Valve Command
 - g. Fan Command
 - h. Fan Status
 - 2. Graphic location specifications as follows:
 - 3. Controller Location – Graphic on folder named after sir handling unit (Ex. AHU01Summary)
 - 4. Navigation Tree Configuration – Under the serving air handler component with named component Terminal Unit Summary.
- D. Exhaust Fan Summary:
- 1. Includes all the exhaust fans not dedicated to a specific air handling unit. The information included in an Exhaust Fan Summary graphics (if available) is as follows:
 - a. Name of Exhaust Fan (Ord to graphic Slot:Title) with hyperlink to graphic.
 - b. Area served (Ord to graphic Slot:Description) with hyperlink to Floorplan.
 - c. Space temperature
 - d. Active space temperature setpoint
 - e. Building/Space Pressure
 - f. Building/Space Pressure Setpoint
 - g. Fan Command
 - h. Fan Status - Linked to trend or chart if available.
 - 2. Graphic location specifications as follows:
 - a. Controller Location – Graphic on EFSummary folder.
 - b. Navigation Tree Configuration – Under the serving air handler component with named component Exhaust Fan Summary.

1.22 FLOORPLANS AND HVAC DETAIL

- A. Each floorplan for a building will be available as a graphic. The HVAC/Detail floorplan will include various points, hyperlinks and a compass indicating a minimum of North. All zones will need to be represented with a polygon object formatted matching the graphic standard. These polygons will be grey and highlight yellow when the mouse hovers over the zone, allowing the zone name to pop-up. A zone would represent a space temperature, air handler space sensors, TU sensors, radiators, etc. Each zone will be hyperlinked to the specific zone graphic. Other links and points will be included if applicable:
1. Zone space temperature and labels are to be located closest to actual physical location of the zone sensor, with hyperlink to equipment graphic.
 2. Any notes or information required for floorplan.
- B. Graphic location specifications as follows:
1. Controller Location – Graphic in floorplans folder, on a folder named matching the graphic name (Example Floorplan_HVAC_01).
 2. Navigation Tree Configuration – Under the Floorplan component in the HVAC component. If it is the only graphic for the floor (Floor not split into smaller graphics), component will match floor number (Floor01). If this is a smaller part of a floor, it will be under the floor number component with component matching the direction (Example West).
- C. Floorplan Navigation:
1. If a floorplan for an individual floor is too large for a single graphic, it will be broken into partial floorplans (e.g., East and West). A floorplan graphic called a Navigation Floorplan will be created. This graphic will show the whole floorplan for its respected floor and show how the floorplan will be segmented with rectangles and labels. Pre-formatted examples are available.
 2. On every partial floorplan graphic (a section of a floorplan from a navigation floorplan), the bottom right corner will include a navigation image. This will be a smaller representation of the whole floor, and highlight the current area being viewed in the active floorplan. Add data center/server (CRAC) critical alarms and fume hood low flow graphic.
 3. Partial floorplans will also have a link in the footer to link back to the corresponding navigation floorplan graphic.
 4. Graphic location specifications as follows:



- a. Controller Location – Graphic in floorplans folder, on a folder named matching the graphic name (ExampleFloorplan_Navigation_01).
- b. Navigation Tree Configuration – Under the Floorplan component in both the HVAC and Lighting component This will be the graphic for the floors that have the split components underneath (Example Floor01).

D. Main Graphics Page:

- 1. Each main graphic page will require hyperlinks to the following graphics when completed:
 - a. Building alarm console.
 - b. All equipment summary pages that are not linked from another summary page (e.g., Lighting Panel Summary graphics are hyperlinked to Lighting Summary pages) named appropriately and hyperlinked to the corresponding summary page.
 - c. Utility Summary.
 - d. Air Compressors.
 - e. Hot Water Plants (With system status).
 - f. Building Heat Exchanger (With system status).
 - g. Chilled Water Plants (With system status).
 - h. Domestic Water and/or Deionized Water (With system status).
 - i. Emergency Generator (With system status).

END OF SECTION

APPENDIX C – DEVICE DATA SPREADSHEET

[illegible][illegible]

Note: Excel spreadsheet will be provided to the contractor in .xlsx format.

END OF SECTION

APPENDIX D – OBJECT NAMING SPREADSHEET

Step 1 – Provide to SRP for Object Naming Acceptance									
Device Name	Proposed Object Name	Object Type	Object Instance ID	Units/Non-Numeric Display	Precision	Trend Type	CoV Tolerance	Trend Interval	Additional Commissioning Trend ☐

Step 1 – Provide to SRP for Object Naming Acceptance					Provided by SRP After Step 1			
Commissioning Trend Interval	Read/Write	Graphic	Alarm	Description	Comments	Acceptance Status	Checked By	Date

Note: Excel spreadsheet will be provided to the contractor in .xlsx format.

END OF SECTION

SECTION 25 09 23
INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Requirements:
 - 1. 25 00 00 Integrated Automation
 - 2. 25 11 00 Integrated Automation Network Devices
 - 3. 25 12 00 Integrated Automation Network Configuration
 - 4. 25 15 00 Integrated Automation Software
 - 5. 26 05 19 Low Voltage Conductors and Cables
 - 6. 26 05 23 Control Voltage Cables
 - 7. 26 05 33 Raceways and Boxes
- B. Coordination with other trades is required wherever architectural features govern the location of Work.

1.2 REFERENCES

- A. Rules and regulations of Federal, State, local authorities, and utility companies in force throughout the contract duration.
- B. Appendix A, Stability and Accuracy Tables
- C. Appendix B, Conductor Requirements Tables
- D. Agencies relevant to this section:
 - 1. ANSI-American National Standards Institute
 - 2. ASHRAE-American Society of Heating, Refrigeration, and Air Conditioning Engineers
 - 3. BTL BACnet Testing Laboratories
 - 4. FCC Federal Communications Commission
 - 5. IEC International Electrotechnical Commission
 - 6. ISO International Organization for Standardization
 - 7. NEC National Electrical Code
 - 8. NEMA National Electrical Manufacturers Association
 - 9. OSHA Occupational Safety and Health Administration
 - 10. TIA Telecommunications Industry Association

11. UL Underwriters Laboratories

E. Publications relevant to this Section:

1. ANSI/ASHRAE-Standard 135-2016, A Data Communication Protocol for Building Automation and Control Networks
2. ANSI TIA/EIA-485-A-2012 Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems
3. IEEE 802.3-2018 IEEE Standard for Ethernet
4. IEEE C62.41.1-2002 IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
5. IEEE C62.41.2-2002 IEEE Recommended Practice on Characterization of Surges in Low- Voltage (1000 V and Less) AC Power Circuits
6. IEEE C62.41.3-2002 IEEE Guide for Interactions Between Power System Disturbances and Surge Protection Devices
7. ISO 16484-5:201 Building Automation and Control Systems (BACS) -- Part 5: Data communication protocol
8. NEMA 250-2018 Enclosures for Electrical Equipment (1000 Volts Maximum)
9. UL 916-2015 Standard for Energy Management Equipment
10. UL 5085-3-2017 Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

1.3 SYSTEM DESCRIPTION

- A. The control system will consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface.
- B. The system will directly control HVAC equipment as specified on the Drawings.
- C. Each field device will be capable of stand-alone operation. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in the sequence.
- D. I/O points, virtual points, schedule objects, trend objects, alarm objects, and point naming conventions will adhere to requirements specified in Division 25 for algorithms.

1.4 QUALITY ASSURANCE

- A. Contractor and Manufacturer Qualifications
 1. The Contractor must have a minimum of five (5) years of demonstrated technical expertise with building automation systems as well as subsystem requiring integration during the project duration. The Contractor must also have an established working relationship with the Control System Manufacturer.

2. The Contractor will have successfully completed Niagara 4 Basic Operator System training. Upon request, Controls Contractor will present record of completed training including course outlines.

1.5 CODES AND STANDARDS

- A. Work, materials, and equipment will comply with the most restrictive local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation will comply with applicable editions of the following codes:
 1. National Electric Code (NEC)
 2. International Building Code (IBC)
 3. International Mechanical Code (IMC)

1.6 SYSTEM PERFORMANCE

- A. System will conform to the following minimum standards over network connections. Systems will be tested using manufacturer's recommended hardware and software for operator workstation.
 1. Custom and standard applications will be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 2. Programmable controllers will be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 3. System will report values with minimum end-to-end accuracy listed in Appendix A, Table 1.
 4. Control loops will maintain measured variable at setpoint within tolerances listed in Appendix A, Table 2.

1.7 SUBMITTAL REQUIREMENTS

- A. Submittals pertaining to this section revolve around field devices only:
 1. Direct Digital Controllers
 2. Field Panels and Enclosures
 3. Transducers and Transmitters
 4. Sensors: must include accuracy data
 5. Actuators
 6. Valves
 7. Relays and Switches
 8. Power Supplies
 9. Batteries
 10. Wiring and Raceways
 11. Hangers and Supports

- B. Provide shop drawings and other submittals on hardware, software, and equipment to be installed or furnished in PDF file format.
- C. Do not begin work until submittals have been approved for conformity with design intent.
- D. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference the covered specifications and drawings on each submittal. General catalogs will not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Controls Contractor of responsibility to supply quantities to complete work.

1.8 SUBMITTALS

- A. The following submittals will be provided initially:
 - 1. Cover page and table of contents for all submitted hardware, software, etc.
 - 2. Hardware Product Data – Provide manufacturer's technical literature for each specified integration device. Minimum technical data requirements must include device dimensions, performance characteristics, electrical characteristics, and installation/startup instructions.
 - 3. PICS statement, BIBB, and BTL listing documents for all BACnet devices.
 - 4. Documentation stating conformance to Modbus Organization for all Modbus devices.
 - 5. Software Product Data - Provide manufacturer's technical literature for the programming software required for each specified integration device. Minimum technical data requirements must include operating system requirements, system resource requirements, programming style, network support, and any required 3rd party drivers and/or applications.
 - 6. Device Configuration - The information required for initial prior to network addressing assignments includes the following:
 - a. Device Name following the SRP standard naming
 - b. Device Description describing all the equipment, systems, or portions thereof that will be controlled or monitored with the device.
 - c. Manufacturer
 - d. Model number
 - e. Series
 - f. Firmware version
 - g. Protocol
 - 7. Schematic diagram of each controlled system with associated control and monitoring points labeled. Graphically show locations of controlled and monitored elements.
 - 8. Schematic wiring diagram of each controlled system. Label control elements, monitoring elements, and terminals.
 - 9. Names used to note controlled and monitored elements must follow the owner standard naming conventions. Names must match between diagrams.

10. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 11. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified on the Drawings. Indicate alarmed and trended points.
 12. For equipment being integrated into systems other than Niagara N4, a graphical representation for each unique system will be required as part of the submittal.
 13. For equipment being integrated into Niagara N4, see Division 25 Section 25 00 00 "Integrated Automation" for submittal graphical requirements.
- B. The following submittals will be provided as part of the programming stage as device information becomes available before devices can be installed on the owner network:
1. Device Configuration – Continuation of Device Configuration requiring the following information before devices are installed are as follows:
 - a. Device Instance Number
 - b. Switch ID
 - c. Port ID
- C. A checkout form will be provided for each device during the Commissioning Process:
1. Prefunctional Testing
 2. Functional Testing
 3. Point-to-point testing
 4. Device Communication Status
 5. Communication Errors and Repair Requirements
 6. GUI Function Tests at All Operator Stations
- D. The following will be provided as part of the final close-out package:
1. Project Record Documents. Submit record (as-built) documents upon completion of installation for approval prior to final completion. Submittals will consist of:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing subcontractors and service representatives for equipment and control systems.
 - c. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - d. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - e. Backup copies of custom programs generated for programmable controllers and must be capable of viewing using furnished programming tools.
 - f. List of recommended spare parts with part numbers and suppliers.

- g. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
- h. Complete original-issue copies of furnished software.
- i. Licenses, guarantees, and warranty documents for equipment and systems.
- j. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

1.9 OWNER TRAINING

- A. Owner training for DDC field equipment will be performed by the Controls Sub-Contractor and will be specific to the control system installed during the project.
- B. The Controls Contractor will provide a course outline and materials at least six weeks before first class. The Engineer will modify course outlines and materials, if necessary, to meet General Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.
- C. Training will not be scheduled until Control System Demonstration and Acceptance have been completed.
 - 1. If control system installation and programming coincide with device integration, owner training for device integration may be completed in parallel with training mentioned within this specification.
- D. Based upon project size, a minimum of 8 hours of training will be provided to owner, organized into two (2) separate sections at four (4) hours a piece, unless otherwise stated by owner.
- E. Provide a factory-trained instructor or representative to give full instructions to designated personnel in the operation, maintenance, and programming of each piece of equipment or system. Instructors shall be thoroughly familiar with aspects of the subject matter. The Contractor will provide equipment and material required for classroom training.
- F. Proposed training instructor qualifications will be provided to owner and subject to approval by owner.
- G. Training will include classroom instruction and hands-on field instruction.
- H. Minimum requirements for classroom instruction are the following:
 - 1. Review of project record documentation
 - a. Each student must be provided a copy of the final project submittals.
 - 2. Maintenance procedures and schedules
 - 3. Pertinent safety requirements

4. Introduction to controller programming and overview of the programming application interface. This will also include:
 - a. Uploading, downloading, and backing up programs
 - b. Review of setpoint optimization and loop tuning concepts
 - c. Configuration of installed devices, modifying system parameters.
 - d. Controller training must be completed in the classroom with networked working controllers that are representative of the installed hardware.
 5. Review of installed components and how to install/replace, maintain, commission, and diagnose them
 6. General review of sequence of operation and control logic for the project site.
 7. Training manuals will be provided and include screen captures with detailed instructional annotation for each step required to complete portions of owner training.
 8. Additional topics can be requested by owner in advance of the training sessions. Each additional topic will require the Contractor to prepare and submit training manuals with the same level of detail as described above.
 9. Training is subject to be recorded by owner for internal use.
- I. Minimum requirements for field instruction:
1. Walkthrough of the project to locate mechanical equipment and associated installed control devices and components.

1.10 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation will become owner's property. This includes, but is not limited to:
1. Record drawings
 2. Database
 3. Application programming code
 4. Documentation

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Products will be stored according to manufacturer's recommendations.
- B. Products will be stored in their original manufacturers packaging until installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved

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in writing by owner. Spare parts will be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. Communications protocol requirements will comply with Division 25.
- B. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- C. Each controller will have a communication port for temporary connection to a laptop computer or other operator interface. Connection will support memory downloads and other commissioning and troubleshooting operations.
- D. Controllers with real-time clocks will use the BACnet Time Synchronization service. System will automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system will automatically adjust for daylight saving and standard time.
- E. System will be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.3 CONTROLLER SOFTWARE

- A. Field controllers must be programmed and configured to function as specified on the Drawings.
- B. Controller applications will be editable through a web browser interface or engineering workstation.
- C. Application programming software will require a username and password to view, edit, add, or delete data.
 - 1. The software must automatically log-out each operator if no keyboard or mouse activity is detected. Operators will be able to adjust automatic log out delay.
 - 2. Security data, such as user passwords, must be stored in an encrypted format. System will not display operator passwords.
- D. Energy Conservation and Peak Demand Management.
 - 1. The building management system will monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
 - 2. When power consumption exceeds adjustable levels, building management system will automatically adjust setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand as specified on the Drawings.

When demand drops below adjustable levels, building management system will restore loads as specified.

3. The building management system will stagger controlled equipment start after unoccupied periods or power outages. Operator will be able to adjust equipment restart order and time delay between equipment restarts.

E. Controllers must provide the following:

1. Direct- and reverse-acting PID (proportional-integral- derivative) algorithms. Each algorithm will have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm will calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
2. Ability to accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
3. Ability to calculate a sliding-window average (rolling average). Operator will be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
4. Ability to prevent equipment short cycling by means of adjustable minimum on-time and off-time settings.
5. Ability to provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
6. Ability to provide an algorithm that can totalize runtime for each binary input and output. Operator will be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified on the Drawings.

2.4 CONTROLLERS

- A. B-ASC controllers used in VAV box applications must be provided with integrated damper actuator and air flow sensor.
- B. Hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors, unless otherwise specified by owner.
- C. Each controller must contain a service communication port for local communication to the device.
- D. Each controller must contain an uninterruptible real-time clock for accurate equipment scheduling. This clock must keep time of day, day of week, month, and year information. The field controller must also be capable of synchronizing its time with the building automation system.
- E. Equipment specified within the project scope will be controlled by a single controller to provide stand-alone control in the event of communication failure. I/O points specified for a piece of equipment will be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

- F. Where a single controller is unable to provide an adequate amount of I/O to fulfill algorithm requirements, the controller may utilize one or more I/O modules to provide additional space. The I/O modules must remain on an isolated network with the host controller.
- G. Controller hardware will be suitable for anticipated ambient conditions.
- H. Controllers used outdoors or in wet ambient conditions will be mounted in waterproof, air conditioned enclosures and will be rated for operation at -29°C to 60°C (-20°F to 140°F).
- I. Controllers used in conditioned space will be mounted in dust-protective enclosures and will be rated for operation at 0°C to 50°C (32°F to 120°F).
- J. Controllers must have diagnostic LEDs for power, communication, and the processor.
- K. Each B-BC and B-AAC selected for the project must have an available option for an integrated local interface with password locked display.
 - 1. The Operator must be able to use the interface to view and edit required data specified by owner.
- L. Controllers must have field removable terminal strips.
- M. Controller memory must support operating system, database, and programming requirements. At the time of commissioning, each controller must demonstrate memory usage and total point count are below the manufacturer's recommended operating limit.
- N. Controllers will retain BIOS and application programming in nonvolatile memory to prevent data loss in the event of a power cycle.
- O. Controllers will be able to operate at 90% to 110% of nominal voltage rating and will perform an orderly shutdown below 80% nominal voltage. Operation will be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
- P. Controllers must be provided with field replaceable fuses for overcurrent protection. Overcurrent protection must be a minimum of 125% of total power consumption.
- Q. Controllers must withstand a humidity range of 0-90%, non-condensing.
- R. Controllers must be license and maintenance cost free to remain functional with any BACnet system.
- S. Controllers must allow for complete communication architecture for all building automation system field devices and any integrated 3rd party devices.
- T. All Modbus device manufacturers must belong to the Modbus Organization.
- U. Controllers must be able to manipulate sequences, timers, setpoints, etc. as required to meet or exceed the design intent of the equipment served.

2.5 MANUFACTURED UNITS

- A. Subject to requirement compliance, devices from one of the following manufacturers are preferred:
 - 1. Acuity Brands/Distech Controls.
 - 2. Honeywell International.
- B. The following are the Basis of Design for Integrated Automation Field Devices. All manufacturers and models are subject to compliance requirements set forth by SRP.
- C. BACnet Advanced Application Controller (B-AAC):
 - 1. Distech Controls ECB-600 Series.
- D. BACnet Application Specific Controller (B-ASC):
 - 1. Distech Controls ECB-203 Series.
 - 2. Distech Controls ECB-VAV Series
- E. BACnet Building Controller (B-BC):
 - 1. Distech Controls ECY-S1000 Series.
- F. BACnet Smart Space Conditions Sensor (B-SS):
 - 1. Distech EC-Smart-Vue Sensor Series.

2.6 BACNET INTEROPERABILITY BUILDING BLOCKS

- A. In addition to the minimum required BACnet Interoperability Building Blocks (BIBBS) for each device profile set forth by ASHRAE, the following will also be required:
 - 1. B-BC:
 - a. DS-COV-A/B
 - b. T-VMT-E-B
 - c. DM-OCD-B
 - 2. B-AAC:
 - a. DS-COV-B
 - b. AE-ESUM-B
 - 3. B-ASC:
 - a. DS-RPM-B
 - b. DS-WPM-B
 - c. DS-COV-B
 - d. SCHED-I-B
 - e. DM-RD-B
 - f. DM-TS-B
 - 4. B-SA

- a. DS-RPM-B
 - b. DS-WPM-B
 - c. DS-COV-B
 - d. DM-RD-B
 - e. DM-TS-B
5. B-SS:
- a. DS-RPM-B
 - b. DS-WPM-B
 - c. DM-TS-B

2.7 PROGRAMMABLE DEVICES

- A. Programmable controllers must be BACnet BTL listed controllers must support local BACnet calendar and scheduling objects, trend objects, and notification objects.
- B. Devices listed with BACnet profile B-BC will be used for any field equipment that consists of multiple pieces of sub equipment (Including terminal controls, VFDs, or integrated communication cards).
- C. Devices listed with BACnet profile B-AAC may be used with all other field equipment that does meet the requirement for B-BC devices and B-BC devices are not available or economical.
- D. Devices listed with BACnet profile B-ASC controllers may be permitted for use so long as it meets all the other criteria required for a programmable controller and neither B- BC or B-AAC devices are not available or economical.
- E. All non-native BACnet controllers must be approved by SRP.
- F. IP devices will be set-up as DHCP devices and must have pre-approved network configuration from SRP following procedure documented in division section *25 00 00 Integrated Automation*
- G. All devices addressing requirements are documented in division section *25 12 00 Integrated Automation Network Configuration*
- H. Multiple field controllers will not be used to control a single piece of equipment where critical sensor data must be sent over the building management network for adequate equipment control. The controls contractor must instead specify field controllers capable of expandable input/output modules.
- I. Any building management system hardware installed on any SRP owned site will not be limited in their ability to communicate with a specific brand

or model.

- J. Controllers will be programmed to function as standalone equipment in the event of a network failure. This includes fallback value setpoints, as well as continued trending and notifications.

2.8 NON-PROGRAMMABLE DEVICES

- A. All devices specified must have any required trending and scheduling setup as BACnet objects internal to the non-programmable device.
- B. Any non-programmable IP devices that will not have the trending and scheduling internally configured will require an Integration Contractor to set up trending scheduling on the Niagara Supervisor.
- C. Any non-programmable serial devices that will not have the trending and scheduling internally configured will require a hard-wired integrator specified as part of the project to configure all trending and scheduling.
- D. Existing integration devices can only be used if approved by SRP prior to project design approval.

2.9 INPUT AND OUTPUT REFERENCE

- A. Each controller must be selected with an additional 20% capacity for each input and output type for expanded capability.
- B. Shorting an input or output point to itself, to another point, or to ground will cause no controller damage. Input or output point contact with up to 24 V for duration will cause no controller damage.
- C. Binary inputs will provide a wetting current of at least 12 mA and will be protected against contact bounce and noise.
- D. Binary inputs will sense dry contact closure without application of power external to the controller.
- E. Pulse accumulation inputs will conform to binary input requirements and will accumulate up to 10 pulses per second.
- F. Analog inputs must be capable of monitoring a minimum of 0-10 VDC, 4-20 mA, or resistance (thermistor or RTD) signals. Analog inputs will be compatible with and field configurable to commonly available sensing devices.

- G. Analog outputs must be capable of modulating a minimum of 0-10 VDC or 4-20 mA signals as required to properly control output devices. Each analog output used in conjunction with major equipment will have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs will not drift more than 0.4% of range annually.
- H. System inputs and outputs that can be designated as either binary or analog in software will conform to the provisions of this section that are appropriate for their designated use.

2.10 POWER SUPPLIES AND LINE

- A. Control transformers will be listed by UL. Furnish Class 2 current limiting type or furnish overcurrent protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
- B. DC power supplies must include the following:
 - 1. Must match output current and voltage requirements.
 - 2. Must have built-in over-voltage and over-current protection and will be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - 3. Must be full-wave rectifier type with an output ripple of 5.0 mV maximum peak-to-peak.
 - 4. Regulation will be 1.0% line and load combined, with 100-microsecond response time for 50% load changes.
 - 5. Must operate between 0°C and 50°C (32°F and 120°F). EM/RF will meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
- C. Line voltage units will be UL Recognized and CSA Listed.
- D. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection will have:
 - 1. Dielectric strength of 1000 V minimum.
 - 2. Response time of 10 nanoseconds or less.
 - 3. Transverse mode noise attenuation of 65 dB or greater.
 - 4. Common mode noise attenuation of 150 dB or greater at 40-100 Hz.
- E. Provide power supplies for BAS digital controllers and I/O extension modules in accordance with the manufacturer's installation instructions. Motorized actuators, field devices on the load side of control relays, and other devices requiring electrical power in addition to the control signal to or from a BAS digital controller will have an operating power source that is different from the power supplies serving the BAS digital controllers.

2.11 AUXILIARY CONTROL DEVICES

- A. Control Valves:

1. Manufacturer: Belimo or approved equal.
 2. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
 3. Provide two- or three-way control valves for two-position or modulating service as shown.
 4. Water Valves:
 - a. Valves providing two-position service will be quick opening.
 - b. Valve actuator and trim will provide the following minimum close-off pressure ratings.
 - 1) 150% of total system pressure for two-way valves.
 - 2) 300% of pressure differential between ports A and B at design flow or 100% of total system pressure for three-way valves.
 - c. Valves providing modulating service will have equal percentage ports.
 - d. Sizing:
 - 1) Line size for two position service.
 - 2) Select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi) for two-way modulating service.
 - 3) Select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi) for three-way modulating service.
 5. Sizing:
 - a. Select pressure drop equal to 10%-20% of inlet psig for two position service.
 - b. Select pressure drop equal to 80% of inlet psig for modulating service at 100 kPa (15 psig) or less.
 - c. Select pressure drop equal to 50% of inlet psig for modulating service at 101-350 kPa (16-50 psig).
 - d. Select pressure drop as scheduled on drawings for modulating service at or over 350 kPa (50 psig).
- B. Electric Damper and Valve Actuators.
1. Manufacturer: Belimo or approved equal.
 2. Must be available with mechanical or electronic stall protection to prevent actuator damage throughout the actuator's rotation.
 3. Actuators used for power-failure and safety applications will have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 4. Actuators used for water valve control will be selected in accordance with manufacturer's recommendations to prevent hydraulic shock.

5. Proportional actuators will accept a 0-10 Vdc or a 0-20 mA control signal and will have a 2-10 Vdc or 4-20 mA operating range.
6. 24 Vac and 24 Vdc actuators will operate on Class 2 wiring.
7. Operators will be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators will have an external manual gear release. Spring- return actuators with more than 7 N·m (60 in.-lb.) torque capacity will have a manual crank.

C. Binary Temperature Devices:

1. Manufacturer: Honeywell or approved equal.
2. Low-voltage space thermostats will be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F- 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
3. Line-voltage space thermostats will be bimetal- actuated, open-contact type or bellows- actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
4. Low-limit airstream thermostats will be UL listed, vapor pressure type. Element will be at least 6 m (20 ft.) long. Element will sense temperature in each 30 cm (1 ft.) section and will respond to lowest sensed temperature. Low-limit thermostat will be manual reset only.

D. Temperature Sensors:

1. Manufacturer: Honeywell or approved equal.
2. Temperature sensors will be Resistance Temperature Device (RTD) or thermistor.
3. Duct sensors will be single point or averaging as shown on drawings. Averaging sensors will be a minimum of 1.5 m (5 ft.) in length per 1 m² (10 ft²) of duct cross-section.
4. Immersion sensors must be provided with a separable stainless steel well. Well pressure rating will be consistent with system pressure it will be immersed in. Well will withstand pipe design flow velocities.
5. Space sensors will have remote setpoint adjustment, occupancy override, vertical wall box enclosure, B-SA Bus screw terminal block, BACnet listed sensor, and communication port.

E. Humidity Sensors:

1. Manufacturer: Honeywell or approved equal.
2. Duct and room sensors will have a sensing range of 20%-80%.
3. Duct sensors will have a sampling chamber.
4. Outdoor air humidity sensors will have a sensing range of 0%-100% RH and will be suitable for ambient conditions of 40°C-75°C (40°F-170°F).
5. Humidity sensors will not drift more than 1% (full scale) annually.

F. Flow Switches:

1. Air Flow:
 - a. Manufacturer: Cleveland Controls or approved equal.
 - b. Flow-proving switches will be differential pressure type or thermal dispersion type air flow switches.
 - c. Differential pressure switches will be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and will have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
2. Water Flow:
 - a. Flow proving switches are not permitted for water service use.

G. Flow Sensors:

1. Air Flow:
 - a. Manufacturer: Ebtron or approved equal.
 - b. Air flow sensors will be solid state thermal dispersion type with steel construction and a flanged face for easy mounting and flow straighteners for circular and rectangular ducts.
 - c. Solid state thermal dispersion type sensors will have field selectable and field scalable analog output signals.
 - 1) Selectable output signals will be at minimum 0-10 VDC and 0-20 mA.
 - 2) Scalable range up to a minimum of 10% over design flow conditions.
 - d. Unit accuracy must meet or exceed parameters listed in Appendix A of this document.
 - e. Air flow sensors and stations will be available with a local display indicating live flow values.
 - f. Air flow sensors and stations will be UL listed with NIST-traceable calibration certification and a NEMA 1 enclosure unless otherwise specified.
2. Water Flow:
 - a. Manufacturer: IFM or approved equal.
 - b. Water flow sensors will be solid state thermal dispersion type with construction material rated for the size and type of piping material.
 - c. Sensors will have field selectable and field scalable analog output signals.
 - 1) Selectable output signals will be at minimum 0-10 VDC and 0-20 mA.
 - 2) Scalable range up to a minimum of 10% over design flow conditions.
 - d. Unit accuracy must meet or exceed parameters listed in Appendix A of this document.
 - e. Water flow sensors will be UL listed with NIST-traceable calibration certification and a NEMA 4 enclosure unless otherwise specified.

H. Condensate Overflow Switches

1. Auxiliary Drain Pan Switch:

- a. Manufacturer: RectorSeal SS3 or approved equal.
 - b. Condensate overflow switches located in an auxiliary drain pan will be the adjustable, ratcheting float style utilizing a magnetic reed switch.
 - c. Provide plenum rated cable where required.
- 2. Auxiliary Drain Line Switch:
 - a. Manufacturer: RectorSeal SS2 or approved equal.
 - b. Condensate overflow switches located in an auxiliary drain pan will be the adjustable, ratcheting float style utilizing a magnetic reed switch.
 - c. Provide plenum rated cable where required.
- I. Relays:
 - 1. Manufacturer: IDEC or approved equal.
 - 2. Control and status relays will be plug-in IDEC type, be UL listed, have dust cover, and have LED "energized" indicator with manual override button. Contact rating, configuration, and coil voltage will be suitable for application.
 - 3. Time delay relays will be solid-state plug-in type, be UL listed, and have adjustable time delay. Delay will be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage will be suitable for application. Provide NEMA 1 enclosure for relays not installed in a local control panel.
- J. Current Transmitters:
 - 1. Manufacturer: Veris or approved equal.
 - 2. AC current transmitters will be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges will be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy will be $\pm 1\%$ full-scale at 500 ohm maximum burden.
 - 3. Transmitter will meet or exceed ANSI/ISA S50.1 requirements and will be UL/CSA recognized.
 - 4. Unit will be split-core type for clamp-on installation on existing wiring.
- K. Current Transformers:
 - 1. All AC current transformers will be UL/CSA recognized and will be completely encased (except for terminals) in approved plastic material.
 - 2. Transformers will be available with various current ratios and will be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
 - 3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.
- L. Voltage Transmitters:
 - 1. Manufacturer: Omega or approved equal.
 - 2. AC voltage transmitters will be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

3. Adjustable full-scale unit ranges will be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy will be $\pm 1\%$ full-scale at 500 ohm maximum burden.
4. Transmitters will meet or exceed ANSI/ISA S50.1 requirements and will be UL/CSA recognized at 600 Vac rating.

M. Power Monitors:

1. Power monitors will be three-phase type and will have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
2. Power monitors will be provided with a selectable pulse rate output for kWh reading. Power monitors will operate with 5 amp current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.

N. Current Switches:

1. Manufacturer: Veris or approved equal.
2. Current-operated switches will be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

O. Pressure Transducers:

1. Manufacturer: Setra or approved equal.
2. Transducers will have linear output signal and field-adjustable zero and span and have a local digital display indicating live flow values.
3. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span will not damage transducer sensing elements.
4. Water pressure transducer diaphragm will be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducers will have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
5. Water differential pressure transducer diaphragm will be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure will be 2000 kPa (300 psi.) Transducer will have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

P. Differential Pressure Switches:

1. Manufacturer: Penn or approved equal.
2. Differential pressure switches will be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and will have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

Q. Pressure-Electric (PE) Switches:

1. Manufacturer: Penn or approved equal.
2. PE switches will be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175

- kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).
3. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.
 4. Switches will be open type (panel-mounted). Exception:
 - a. Switches will be the enclosed type for remote installation. Enclosed type will be NEMA 1 unless otherwise specified.
 5. Each pneumatic signal line to PE switches will have permanent indicating gauge.
- R. Local Control Panels:
1. Manufacturer: Hoffman or Siemens only.
 2. Indoor control panels will have fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key will open each control panel and subpanel.
 3. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals will be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
 4. Each local panel will have a control power source power switch (on-off) with overcurrent protection.
 5. Each panel will be sized to accept 20% more controller units than originally installed for expansion.
 6. Outdoor control panels will be cooled by a packaged air conditioning unit like the Rittal Thermoelectric Enclosure Cooling Unit or approved equal.
- S. Environment:
1. Auxiliary Control Devices will be suitable for anticipated ambient conditions.
 2. Devices used outdoors or in wet ambient conditions will be mounted in waterproof enclosures and will be rated for operation at -29°C to 60°C (-20°F to 140°F).
 3. Devices used in conditioned space will be mounted in dust-protective enclosures and will be rated for operation at 0°C to 50°C (32°F to 120°F).
 4. The Devices themselves will possess the appropriate NEMA Rating for the intended environment. Plastic covers, canvas bags, or other supplemental enclosures are unacceptable.

2.12 WIRING AND RACEWAYS

- A. Conductors will conform to tables listed in Appendix B, Conductor Requirements Tables.
- B. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- C. Insulated wire will use copper conductors and will be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate work with work of others. Controls Contractor will perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor will protect against and be liable for damages to performed work and/or damages to material caused by work performed by the Controls Contractor, work performed by the Controls Contractor's employees, and/or work performed by the Controls Contractor's Subcontractor.
- B. Controls Contractor will be responsible for work and equipment until inspected, tested, and accepted by owner.
- C. Protect material when not immediately installed.
- D. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site:
 - 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades.
 - 2. If installation without coordination causes interference with work of other trades, Controls Contractor will correct conditions without extra charge.
 - 3. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Test and Balance:
 - 1. Provide the Test and Balance Contractor with a single set of necessary tools to interface to control system for testing and balancing.
 - 2. Train Test and Balance Contractor to use control system interface tools.

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3. Provide a qualified technician to assist with testing and balancing a minimum of the first 20 terminal units.
4. Test and Balance Contractor will return tools undamaged and in working condition at completion of testing and balancing.

C. Life Safety:

1. Duct smoke detectors required for air handler shutdown are provided under Division 28.
2. Interlock smoke detectors to air handlers for shutdown as specified on the Drawings.
3. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23.
4. Interlock smoke dampers to air handlers as specified on the Drawings.
5. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23.
6. Fire and smoke damper control is provided under Division 28.

D. Coordination with Other Controls:

1. Integrate with and coordinate controls and control devices furnished or installed by others as follows:
 - a. Integration and operator interface software and hardware will be provided by the Integration Contractor, as specified in Division 25.
 - b. Integration Contractor will be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.
 - c. Communication media and equipment will be provided as specified on the Drawings.
 - d. Each supplier of controls products will configure, program, start up, and test the product to meet the sequences of operation described in the Drawings, regardless of where within the contract documents those products are described.
 - e. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.

- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring will comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

- A. Work, materials, and equipment will comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in the Drawings.
- B. Continually monitor field installation for code compliance and workmanship quality.
- C. Controls Contractor will arrange for work inspection by the Owner.

3.6 EXISTING EQUIPMENT

- A. Interconnecting control wiring to be removed will become Controls Contractor's property unless specifically noted or shown to be reused.
- B. Existing control panels not scheduled for reuse will be removed and delivered to owner.
- C. Unless otherwise directed, Controls Contractor is not responsible for repair or replacement of existing energy equipment and systems, valves, dampers, or actuators. Notify Engineer in writing immediately of existing equipment that requires maintenance.
- D. Ensure proper operation of indicator gauges. Recalibrate gauges for reasonable accuracy or replace if calibration cannot bring accuracy into acceptable tolerance.
- E. Deliver the following to owner if project includes new replacements:
 - 1. Existing room thermostats.
 - 2. Existing sensors and transmitters.
 - 3. Existing controllers and auxiliary electronic devices.
 - 4. Existing damper actuators, linkages, and appurtenances.
 - 5. Existing control valves.
- F. Existing mechanical system may be disabled temporarily for work to be performed during the project. A request for equipment downtime must be made to owner at least seven (7) days prior to work that is to be performed. Execution of work may not commence without approval from owner.
- G. Maintain fan scheduling using existing or temporary time clocks or control systems throughout the control system installation.
- H. Modify existing starter control circuits, if necessary, to provide hand-off-auto control of each controlled starter. Furnish new starters or starter control packages as required.

- I. Patch holes and finish to match existing walls.
- J. At owner's request, items not to be delivered to owner will instead be properly disposed of. Hazardous materials will be disposed of under Division 02.

3.7 WIRING

- A. Control and interlock wiring and installation will comply with national and local electrical codes, Division 26, and manufacturer's recommendations.
- B. NEC Class 1 (line voltage) wiring will be UL listed in approved raceway as specified by NEC and Division 26.
- C. Low-voltage wiring will meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- D. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums will be UL listed for the intended application.
- E. Install wiring in raceway where subject to mechanical damage and at levels below 10ft in mechanical, electrical, or service rooms and above hard ceilings or over large pieces of equipment.
- F. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment will not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- G. Do not install wiring in raceway containing tubing.
- H. Do not splice wires between devices and controllers. A single, continuous wire must be used.
- I. Use of wire nuts is not permitted, except in junction boxes at remote field devices not provided with an OEM terminal strip. Wiring will be terminated or connected using terminals.
- J. Class 2 wiring that is unable to be installed in raceways will be installed above ductwork and equipment at the highest point possible, run parallel or perpendicular to a surface, and supported at (5 ft.) intervals.
- K. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- L. Anchored cables will be supported by J-Hooks or bridle rings. The use of cable ties is not permitted.

- M. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes will not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- N. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- O. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- P. Use color-coded conductors throughout.
- Q. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- R. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment.
- S. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- T. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- U. Terminate control and interlock wiring for the work in this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations. Provide a final copy in the associated control panel.
- V. Flexible metal raceways and liquid-tight flexible metal raceways will not exceed 1 m (3 ft.) in length and will be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- W. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.8 COMMUNICATION WIRING

- A. Communication wiring will be low-voltage Class 2 wiring and will comply with the sequence of operations in the Drawings.
- B. Existing communication wiring will not be reused, unless otherwise specified by owner.
 - 1. If communication wiring is to be reused, it will be the responsibility of the Controls Contractor to verify existing wiring adheres to the medium and topology requirements of the selected communication protocol.
- C. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.

- D. During installation, do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- E. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- F. Install the lightning arrestors according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- G. Each run of communication wiring will be a continuous length without splices when that length is commercially available. Splices in communication wiring are not permitted.
- H. Label communication wiring to indicate origination and destination.
- I. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- J. BACnet MS/TP communications wiring will be installed in accordance with ASHRAE/ANSI Standard 135-2016. This includes but is not limited to:
 - 1. The network will use shielded, twisted-pair cables with a characteristic impedance between 100 and 130 ohms. Distributed capacitance between conductors will be less than 100 pF per meter (30 pF per foot.).
 - 2. Network topology for BACnet MS/TP will be daisy chain only with a maximum unit load count of 32 per network segment. Other networking topologies and T taps are not permitted.
 - 3. Additional unit loads may not be accommodated using repeaters.
 - 4. The maximum length of an MS/TP segment is 1200 meters (4000 ft.) with AWG 18 cable and a maximum baud rate of 76800. A baud rate of 115200 will reduce to recommended maximum length of an MS/TP segment to 1000 meters (3280 ft.) The use of greater distances and/or different wire gauges must comply with the electrical specifications of EIA-485.
 - 5. The maximum quantity of unit loads per segment will be 32, as specified in the EIA 485 standard. Additional unit loads may not be accommodated using repeaters.

3.9 FIBER OPTIC CABLE

- A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension will be within cable manufacturer's specifications.
- B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.10 CONTROLLER INSTALLATION

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- A. Existing field controllers will remain as they are at the time of the project and will be integrated into the Niagara N4 building management system without loss of functionality.
- B. Functional tests on existing field controllers will be performed prior to integration into the Niagara N4 building management system. If an existing field controller is unable to be integrated into the Niagara N4 building management system due to loss of functionality, the specific losses in function will be documented and a replacement field controller will be quoted by the controls contractor and presented to SRP for evaluation. SRP will then determine how to proceed with the field controller in question.
- C. The Controls contractor will provide the new field controllers, and all required miscellaneous hardware for system monitoring and control of equipment.
- D. New field controller location and connection to the SRP building management system must be approved by SRP prior to any work performed.
- E. All device addresses will be set up as indicated in section 25 12 00 *Integrated Automation Network Configuration*.
- F. Existing controllers will not be readdressed, unless otherwise specified by SRP.
- G. Provide additional input and output modules as required to meet point list requirements. Total required inputs and outputs must be approved by SRP prior to any work performed.

3.11 CONTROLLER SCHEDULES

- A. Scheduling as defined in this section will be completed by Controls Contractor or documented to proper completion by Integration Contractor as defined in section 25 00 00 *Integrated Automation*.
- B. Schedules will be set up as BACnet Schedule Objects and will follow the SRP Object Naming Standard
- C. Devices that support BACnet schedule objects must be configured directly in the device.
- D. Devices that do not support BACnet schedule objects must be configured in the IP device routing the serial device.
- E. Scheduling that cannot be configured internally or in a device through which it is routed must be presented to SRP with where scheduling will be completed and how it will flow over the network.
- F. Scheduling in programmable devices will be set up as follows:

1. Building schedule set up as a binary schedule object will be BACnet linked from Niagara Supervisor
2. Equipment schedule set up as an analog schedule object will be BACnet linked from Niagara supervisor
3. When equipment schedule is 0, the building schedule will be the active schedule
4. When the equipment schedule is 1 (unoccupied) or 2 (occupied) the equipment schedule will be the active schedule.
5. If any optimized start/stop operation is required, refer to [REFERENCE] for required configuration.

- G. Any zoned system will utilize specific schedules for individual zone control.
- H. Schedule programming will have BACnet a BACnet binary object indicating which schedule is active in the device.
- I. Schedule programming will have a BACnet binary object failing to a null value, allowing the bypass control of the schedule.

3.12 CONTROLLER TRENDING

- A. Trending as defined in this section will be completed by Controls Contractor or documented to proper completion by Integration Contractor as defined in section 25 00 00 *Integrated Automation*.
- B. Devices that support BACnet trend objects must be configured directly in the device.
- C. Devices that do not support BACnet trend objects must be configured in the IP device routing the serial device.
- D. Trending that cannot be configured internally or in a device through which it is routed must be presented to SRP with where trending will be completed and how it will flow over the network.
- E. Devices will be set up to export trends as BACnet objects directly to the supervisor.
- F. Trending will be named to match the object naming standard. This will be the object name with a trend identification at the end of the name to provide a unique object name.
- G. Trending in programmable controllers will be set up as follows:
1. Hardwired points and points from COM link devices will be trended.
 2. Calculated and read-only virtual points will be trended. Write points will not be trended unless otherwise noted in the project design documents.
 3. Modulating commands and calculated setpoints will be set up as

COV trends with the pre- defined change value at least 1% of the intended range of the control.

4. All measurements and other analog points will be set up as INT trends with the pre- defined time value at 5 minutes.
- H. Trending in non-programmable controllers will be set up as follows:
 1. Only points proxied to the front-end graphics will be trended.
 2. All proxied points that indicate state or mode will be set up as COV trends.
 3. All analog points for monitored values will be set as INT trends with the pre- defined time value at 5 minutes.
 4. All binary points will be set up as COV trends.
- I. Trending setup and discovery in supervisor will be completed by Integration Contractor and is referenced in section *25 15 00 Integrated Automation Software*

3.13 CONTROLLER NOTIFICATIONS

- A. Notifications as defined in this section will be completed by Controls Contractor or documented to proper completion by Integration Contractor as defined in section *25 00 00 Integrated Automation*.
- B. Notification will be set up as BACnet Notifications Objects and will follow the SRP Object Naming Standard
- C. Devices that support BACnet Notification Objects have all notification programmed internally
- D. Devices that do not support BACnet Notification Objects must be configured directly in the IP device to which it is hardwired.
- E. Notifications that cannot be configured internally or in a device to which it is directly hard- wired must be presented to SRP with where alarming will be completed and how it will flow over the network.
- F. Notifications in programmable controllers will be set up as follows:
 1. Notification parameters will be programmed into device and have a binary BACnet object following the SRP Object Naming Standard
 2. Binary BACnet objects for alarm objects will be set up with trending as stated in the Trending section of this division.
 3. No hardwired objects will be referred to as alarm but instead as a status or a relay, as defined in the object Naming Standard
 4. All alarms and notifications will be configured as OFFNORMAL
 5. All failed sensors or loss of communication to devices will be configured as FAULTS

3.14 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal sensor wires in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 3 m (1 ft.) of sensing element for each 1 m² (1 ft²) of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat- conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure:
 - 1. Piping to pressure transducer pressure ports will contain a capped test port adjacent to transducer.
 - 2. Supply and return duct static pressure sensors will pipe the high-pressure tap to the duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building static pressure sensor's low-pressure port will be piped to the static pressure port located on the outside of the building through a high-volume accumulator. The high-pressure port will be piped to a room pressure pickup port cover at the agreed upon location.
 - 4. Pressure transducers, except those controlling VAV boxes, will be in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration- free location accessible for service without use of ladders or special equipment.
- J. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches will be hard-wired to de-energize equipment as described in the sequence of operation.

Switches will require manual reset. Provide contacts that allow DDC software to monitor the status safety switches.

- L. Install discharge air temperature sensors far enough downstream of heaters to demonstrate accurate results free of stratification and hunting.

3.15 FLOW SWITCH INSTALLATION

- A. Adjust flow switch according to manufacturer's instructions.

3.16 FLOW SENSOR INSTALLATION

- A. Use correct sensor for application per manufacturers recommendations.
- B. Calibrate flow sensor according to manufacturer's instructions.

3.17 ACTUATORS

- A. Mount actuators and adapters according to manufacturer's recommendations.
- B. Actuators requiring adaptors must use adaptors approved by the manufacturer.
- C. Electric and electronic damper actuators will be mounted directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
- D. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
- E. To compress seals when spring-return actuators are used on normally closed dampers, power actuators to approximately 5° open position, manually close the damper, and then tighten linkage.
- F. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- G. Provide necessary mounting hardware and linkages for actuator installation.

3.18 WARNING LABELS

- A. Affix permanent warning labels to equipment that can be automatically started by the control system.
 - 1. Labels will use white lettering (12-point type or larger) on a red background.

2. Warning labels will read as follows.

CAUTION

This equipment is operating under automatic control and may start or stop at anytime without warning. Switch disconnect to "Off" position before servicing.

- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
1. Labels will use white lettering (12-point type or larger) on a red background.
 2. Warning labels will read as follows.

CAUTION

This equipment is fed from more than one power source with separate disconnects. Disconnect power sources before servicing.

3.19 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
- B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show instrument or item served.
- D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- E. Label each control component with a permanent label. Label plug-in components such that labels remain stationary during component replacement.
- F. Label room sensors related to terminal boxes or valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels will be visible and legible after equipment is installed.
- H. Label identifiers will match record documents.

3.20 PROGRAMMING

- A. Devices and objects will adhere to the object naming standard referenced in Appendix A of Division 25.

- B. Programming will provide actions for each situation. Graphic or parameter based programs will be documented. Programs will be modular, structured, and have comments to clearly describe each section of the program.
- C. Programs will adhere to sequences of operation specified in the Drawings. Program documentation or comment statements will reflect language used in sequences of operation.

3.21 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Complete startup testing to verify operational control system before notifying owner of system demonstration. Provide owner with schedule for startup testing. Owner or Commissioning Agent must be present during startup testing.
 - 1. Controls Contractor will collaborate with owner and/or a consultant on behalf of owner during the commissioning process.
 - 2. Calibrate and prepare for service each instrument, control, and accessory equipment.
 - 3. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 - 4. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
 - 5. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
 - 6. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
 - 7. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
 - 8. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning for minimum overshoot (<10%) and maximum response.
 - 9. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - 10. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - 11. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.22 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to specified tests. Provide Engineer with log documenting completion of startup tests.
1. Commissioning Agent will be present to observe and review system demonstration. Notify Commissioning Agent at least 10 days before system demonstration begins.
 2. Complete approved checklists and forms for each system as part of system demonstration.
 3. Demonstrate actual field operation of each sequence of operation as specified in the Drawings. Provide at least two people equipped with two-way communication. Demonstrate calibration and response of input and output points requested by Commissioning Agent. Provide and operate test equipment required to prove proper system operation.
 4. Demonstrate compliance with sequences of operation through each operational mode.
 5. Demonstrate complete operation of operator interface.
 6. Demonstrate each of the following:
 - a. DDC loop response. Supply graphical trend data showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate will be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data will show setpoint, actuator position, and controlled variable values. The Commissioning Agent will require further tuning of each loop that displays unreasonably under- or over-damped control.
 - b. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data will document action sampled each minute over at least a 30-minute period and will show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
 - c. Building fire alarm system interface.
 - d. Trend logs for each system. Trend data will indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in the Drawings. Functional test logs will cover three 48-hour periods. Logs will be accessible through system's operator interface and will be retrievable for use from each field device as specified in Division 25.
 7. Tests that fail to demonstrate proper system operation will be repeated after Controls Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.
- B. Acceptance.
1. After tests described in this specification are performed to the satisfaction of both Engineer and owner, Engineer will accept control system as meeting completion requirements. The Commissioning Agent may exempt tests from completion requirements that cannot be performed due to circumstances beyond Controls

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Contractor's control. The Commissioning Agent will provide written statement for each exempted test. Exempted tests will be performed as part of warranty.

2. System will not be accepted until completed demonstration forms and checklists are submitted and approved as required in the Drawings and trend logs created for the purpose of system demonstration and commissioning are disabled and trend data from the disabled trend logs are purged from the building management system.

3.23 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and paint to match adjacent areas.

END OF SECTION

APPENDIX A – STABILITY AND ACCURACY TABLES

TABLE 1: REPORTING ACCURACY

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15°C (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Note 1: Accuracy applies to 10% - 100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

TABLE 2: CONTROL STABILITY AND ACCURACY

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±0.5°C (±1.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

APPENDIX B – CONDUCTOR REQUIREMENTS TABLES

TABLE 1: WIRE INFORMATION

USAGE	SHEATH COLOR	GAGE/QTY	SHIELDED	PLENUM RATED	WCW Part Number
Analog Inputs	Yellow	18-2	Yes	Yes	WCW-18/2YEL-WC
Analog Inputs	Yellow	18-3	Yes	Yes	WCW-18/3YEL-WC
Analog Outputs	Tan	18-2	Yes	Yes	WCW-18/2TAN-WC
Analog Outputs	Tan	18-3	Yes	Yes	WCW-18/3TAN-WC
Binary Inputs	Orange	18-2	Yes	Yes	WCW-18/2ORG-WC
Binary Outputs	Violet	18-2	Yes	Yes	WCW-18/2VLT-WC
24v Power	White with Red Stripe	18-2	No	Yes	002361
24v Power	White with Blue Stripe	16-2	No	Yes	001362
24v Power	White with Yellow Stripe	14-2	No	Yes	007963
FC Bus	Yellow with Blue Stripe	22-3	Yes	Yes	0043339
SA Bus	Brown	22-2P	Yes	Yes	WCW-22/2P-SA-PLN
IP Comm	Purple	23-4P	No	Yes	5566050A
IP Stats	Orange	23-4P	No	Yes	5566040A

Note: The Windy City Wire Part Number is the basis of design. Comparable cables from other manufacturers may be acceptable.

SECTION 25 11 00
INTEGRATED AUTOMATED NETWORK
DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section defines the requirements for any network equipment required to move data between networks or translate data to an IP network layer.
- B. Related Sections:
 - 1. 25 00 00 Integrated Automation
 - 2. 25 14 00 Integrated Automation Local Control Units
 - 3. 25 15 00 Integrated Automation Software

1.2 REFERENCES

- A. Refer to 25 00 00 Integrated Automation.

1.3 ACRONYMS

- A. Refer to 25 00 00 Integrated Automation.

1.4 DEFINITIONS

- A. Refer to 25 00 00 Integrated Automation.

1.5 SYSTEM DESCRIPTION

- A. Refer to 25 00 00 Integrated Automation.

1.6 SUBMITTALS

- A. Refer to 25 00 00 Integrated Automation.
- B. Network Layout submittal will be required prior to any product approval.
- C. Network Configuration submittal will be required prior to execution of any work.

1.7 QUALITY ASSURANCE

- A. New devices used for transport of BACnet data must be native-BACnet and BTL listed unless otherwise approved by SRP.

- B. Coordinate all related network infrastructure changes with SRP before execution of the work.
- C. Network configuration and device identification is configured by SRP and must be pre- approved prior to set-up and execution.
- D. The control system contractor will confirm compatibility between supervisory software and server hardware.
- E. Any devices will have SRP set up as administrative user, and all default user and administration accounts will be deactivated or removed.
- F. Refer to 25 00 00 Integrated Automation.

1.8 WARRANTY

- A. Refer to 25 00 00 Integrated Automation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Any network device proposed for permanent installation must adhere to the following:
 1. Must utilize BACnet/IP as one of its primary communication protocols and must be discoverable on any BACnet network.
 2. Must be license and maintenance cost free to remain functional with any BACnet system.
 3. Must have full set-up and configuration available through IP address connection in web browser.
 4. Must come with a secondary RJ45 communication port for temporary local connection to the controller. This connection must support data backup, commissioning, programming, and configuration functions.
 5. Must not be limited in their ability to communicate with a specific brand or model with exception of approved gateways for proprietary network applications.

2.2 MANUFACTURED UNITS

- A. The following are the Basis of Design for Integrated Automated Network Devices. All makes and models are subject to compliance requirements set forth by SRP.
- B. All products must be new, currently manufactured, and supported by the manufacturer.
- C. Spare parts or replacement equipment must be available for a minimum of 5 years after contract completion.
- D. Bridges:
- E. Siemens SCALANCE XC Series.Routers:

INTEGRATED AUTOMATED NETWORK DEVICES

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1. Contemporary Controls BASRT-B (Unmanaged, temporary use by contractor).
 2. Cisco CSR 1000V (For Cloud and SaaS applications).
- F. Gateways:
1. Babel Buster BB3-7101 (B-GW).
- G. Integrators:
1. Niagara Jace 8000 (B-BC).

2.3 BACNET INTEROPERABILITY BUILDING BLOCKS

- A. In addition to the minimum required BACnet Interoperability Building Blocks (BIBBS) per each device profile set forth by ASHRAE, the following will also be required:
1. B-BC:
 - a. DS-COV-A/B
 - b. DS-M-A
 - c. DS-V-A
 - d. AE-VN-A
 - e. AE-VM-A
 - f. SCHED-VM-A
 - g. T-ATR-A
 - h. T-V-A
 - i. DM-TS-A
 - j. DM-R-B
 - k. DM-OCD-B
 - l. DM-ANM-A
 - m. DM-ADM-A
 - n. DM-ATS-A
 - o. DM-MTS-A
 2. B-GW:
 - a. DS-RPM-B
 - b. DS-WPM-B
 - c. DS-COV-B
 - d. DM-RD-B

2.4 BRIDGES

- A. Bridges are not approved for installation on SRP network.
- B. All required connections across different data-link layers will need to be documented and submitted to SRP for approval and to be configured by SRP on the SRP network.
- C. Bridges required for proprietary sub-network will not be connected to the SRP network and must be approved by SRP.

2.5 ROUTERS

- A. Routers are not approved for installation on the SRP network by any party other than SRP.
- B. Wireless devices are not approved for use on the SRP network, and any sub-network wireless devices will need to be approved by SRP.
- C. Any routers temporarily installed for remote access must be approved by SRP prior to installation. While installed, no device connected to or accessible from the router will be on the SRP network.
- D. Any routers required for Cloud/SaaS applications will be approved by SRP to assess any security issues or concerns with the SRP network.

2.6 GATEWAYS

- A. Gateways may be installed for translation of communication protocols to BACnet/IP for devices that are not native BACnet/IP from the manufacturer.
- B. Gateways will only be approved where BACnet Building Controllers or Integrators are not an economical or viable option.
- C. Gateways installed for permanent use must adhere to following:
 - 1. BTL and UL Listed
 - 2. Web configuration.
 - a. No additional software will be required to configure the gateway.
 - 3. Capable of baud rates at 76800 or greater.
 - 4. Capable of DHCP configuration.
 - 5. Rated for operation at 0°C to 50°C (32°F to 120°F).
 - 6. DIN rail mountable.

2.7 INTEGRATORS

- A. Integrators must be approved for installation on the SRP network.
- B. Integrators will be configured as BACnet devices. Data sent and received between multiple integrators and/or the network supervisor must use the BACnet protocol, unless otherwise specified by SRP.
- C. Trend and scheduling objects must be configurable and data store storage available in any integrator.
- D. Integrators may be used as an input monitoring device so long as IO modules for monitoring only if they are installed for primary use as an integrator and is more economical than another device installation.
- E. Integrators must also adhere to the following:
 - 1. Must be capable of acting as a protocol gateway between network supervisor and field devices.
 - 2. Must be capable of acting as a BACnet Broadcast Management Device (BBMD).

INTEGRATED AUTOMATED NETWORK DEVICES

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3. Must be modular in nature to allow for future capacity expansion. This includes data storage capacity as well as necessary IO modules for monitoring purposes.
4. Integrators with point count or device count limitations must be sized for total point and/or device count plus 10% capacity.
5. Must include an uninterruptible real time clock. This clock must keep time of day, day of week, month, and year information. The supervisory controller must also be capable of synchronizing its time with the building automation server, and sync time to all field level controller.
6. BTL and UL listed.
7. DIN rail mountable.
8. Minimum of 4GB of flash storage space.
9. Must support SSL and TLS encryption.

PART 3 - EXECUTION

3.1 NETWORK COMMUNICATION REQUIREMENTS

- A. For network communication requirements reference section *25 12 00 Integrated Automation Network Configuration*

3.2 GENERAL INSTALLATION

- A. All control wiring and device installation will comply with any national and local electrical codes, Division 26, and any manufacturer recommendations. Where the requirements of Section 25 00 00 differ from Division 26, Division 26 will take precedence but will not supersede any additional requirements noted herein.
- B. All network activities will be coordinated with SRP prior to any work performed.
- C. Beginning installation means contractor accepts existing conditions.
- D. Verify elevations and measurements prior to installation of materials.
- E. Verify door swings for proper clearance before installing.
- F. Coordinate final locations, sizes, and rough-in dimensions for access doors.
- G. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform.
- H. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- I. Install equipment with ample space allowed for removal, repair, or changes to equipment. Provide easy access to equipment and wiring without requiring movement of other equipment, which is to be installed or which is already in place.
- J. Conceal wiring in conduit in mechanical spaces, above hard ceilings, and other

INTEGRATED AUTOMATED NETWORK DEVICES

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spaces where exposed wiring could be damaged.

- K. Provide enough slack, flexible connections, and isolation to allow for equipment vibration.
- L. Provide temporary service, routing of service, or other temporary requirements to minimize downtime of service.
- M. Coordinate final locations, sizes, and rough-in dimensions for access doors.
- N. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.3 INTEGRATORS

- A. Any new Integrators installed on the network will pass all data as BACnet objects over the SRP IP network. No data will be shared as any other language unless approved by SRP for specific applications.
- B. Integrators must be used as gateways only for devices that are not capable of trending or scheduling and where no BACnet Building Controller is available.
- C. Must be furnished with an uninterruptible power supply if one did not previously exist. This uninterruptible power supply must only supply emergency power for their respective supervisory controller and must adhere to the following:
 - a. DIN rail mounted within the same controller enclosure.
 - b. Emergency power for a minimum of one hour.
 - c. Outputs for UPS alarms and status.
- D. For network setup and configuration reference section *25 12 00 Integrated Automation Network Configuration*

END OF SECTION

SECTION 25 12 00

INTEGRATED AUTOMATION NETWORK CONFIGURATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section defines the networking protocols to be utilized by the SRP building automation network.
- B. Related Sections:
 - 1. 25 00 00 Integrated Automation
 - 2. 25 11 00 Integrated Automation Network Devices

1.2 REFERENCES

- A. Refer to *25 00 00 Integrated Automation*.

1.3 DEFINITIONS

- A. Refer to *25 00 00 Integrated Automation*.

1.4 SYSTEM DESCRIPTION

- A. Refer to *25 00 00 Integrated Automation*.

1.5 SUBMITTALS

- A. Refer to *25 00 00 Integrated Automation*.

1.6 QUALITY ASSURANCE

- A. Coordinate all related network infrastructure changes with SRP. Any changes to network components or infrastructure without prior authorization from SRP is not permitted.
- B. Network configurations for IP devices is assigned by SRP, and any devices not matching the approved designation will not be allowed on the SRP network.
- C. All new BACnet devices must be BTL listed unless otherwise approved by SRP.
- D. All Modbus devices must be a member of the Modbus Organization and must comply with all Modicon protocol standards.
- E. BBMD devices can only be setup on the SRP network with SRP approval.

INTEGRATED AUTOMATION NETWORK CONFIGURATION

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1.7 WARRANTY

- A. Refer to *25 00 00 Integrated Automation*.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SITE WIDE GENERAL NETWORK COMMUNICATION REQUIREMENTS

- A. All network activities will be coordinated with SRP prior to any work performed.
- B. Field devices will be integrated to the enterprise level utilizing the BACnet/IP protocol.
- C. Integrators will convert all serial communications to BACnet/IP for integration into the supervisors.
- D. Any field devices with a separate enterprise level that cannot be translated to BACnet/IP shall be capable of data sharing via an XML data transfer process.
- E. Portions of the SRP building management system lie on a local VLAN. These existing legacy components will remain as is unless otherwise specified by SRP.
- F. New building management TCP/IP devices will utilize DHCP. Static IP devices are not permitted unless otherwise specified by SRP.
- G. For IP devices, SRP will provide IP address configuration and device. The Controls Contractor will configure and assign the following as follows:
 - 1. Each sub network ID will be the IP address and the number of routed networks on the device as a single digit-number.
 - 2. Devices will be given unique sequential instance IDs from instance IDs with no skipped values.
 - 3. Devices will be given device ID that matches the network ID on which it resides followed by the device instance ID as a two digit-number.
- H. The below protocols are permitted on the SRP building management network:
 - 1. BACnet
 - a. BACnet/IP is permitted everywhere.
 - b. BACnet MS/TP is permitted in limited capacity. See section 3.2 for details.
 - 2. Modbus
 - a. Modbus TCP
 - b. Modbus RTU in limited capacity. See section 3.2 for details.

INTEGRATED AUTOMATION NETWORK CONFIGURATION

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3. TCP/IP
 - a. Tridium FOX/FOX5
4. HTTP/HTTPS

3.2 CONTROL AND MONITORING OF NETWORK COMMUNICATION

- A. Any new IP device will have the ethernet protocol disabled prior to installation onto the SRP building management network.
- B. New field devices will be BACnet/IP, unless building design constraints deem BACnet/IP as an ineffective design option.
 1. For equipment where BACnet/IP is not an effective option, BACnet MS/TP may be permitted upon approval by SRP. These circumstances are:
 - a. Where it makes sense to use a single BACnet/IP controller on a major piece of equipment to route data from multiple minor devices, such as VAV boxes.
 - b. To integrate 3rd party devices that do not support BACnet/IP, such as VFDs or packaged roof top units.
- C. New metering devices will be BACnet/IP. Where BACnet/IP is unavailable for metering devices, Modbus TCP is the acceptable alternative. Metering devices will not utilize serial RS-485 communication protocols unless otherwise specified by SRP.
- D. IP device ports will be configured as follows:
 1. IP port 1 will be configured to the approved SRP IP device configuration parameters.
 2. Where available, IP port 2 will be configured to a generic IP address specified by the SRP device configuration standards for direct connection.
 3. Any additional IP ports will be disabled.

END OF SECTION

SECTION 25 15 00
INTEGRATED AUTOMATION SOFTWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section defines the requirements for any supervisory software or software setup required to read and write data across the network, store and archive data, and display data in a graphical user interface.
- B. Related Sections:
 - 1. *25 00 00 Integrated Automation*
 - 2. *25 14 00 Integrated Automation Field Devices*

1.2 REFERENCES

- A. Refer to *25 00 00 Integrated Automation*.

1.3 ACRONYMS

- A. Refer to *25 00 00 Integrated Automation*.

1.4 DEFINITIONS

- A. Refer to *25 00 00 Integrated Automation*.

1.5 SYSTEM DESCRIPTION

- A. Refer to *25 00 00 Integrated Automation*.

1.6 SUBMITTALS

- A. Refer to *25 00 00 Integrated Automation*.

1.7 QUALITY ASSURANCE

- A. SaaS and Cloud based applications must adhere to the following national and international standards:
 - 1. ISO/IEC 27001
 - 2. ISO/IEC 27017

1.8 WARRANTY

- A. Refer to *25 00 00 Integrated Automation*.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Non-SRP hosted servers or workstations will not be permitted for installation. Any hardware requirements for software installation will be coordinated with SRP for virtual server requirements and access.
- B. Any licensing or service level agreements must adhere to the following requirements:
 - 1. SRP listed as the owner
 - 2. Open to third-party services and applications, and not limited to a specific brand, contractor, or manufacturer
 - 3. Listed as OPEN for maintenance and upgrades, not limiting to a specific contractor or brand of software unless software is brand specific. Tridium is not a brand specific product.
- C. Software installed on-site will not be licensed for expiration where the software will cease to function fully as when license is not expired.
- D. For any proprietary systems that do not have a BACnet/IP option for communication between field devices and Niagara Supervisor, supervisory software must be capable of XML data transfer to and from the Niagara Supervisor.

2.2 SAAS AND CLOUD BASED APPLICATIONS/STORAGE

- A. All information will be available for export by the customer to a standard usable file format at any time
- B. Any data stored at rest or in transit between the cloud service and SRP will be encrypted.
- C. Any SaaS must have a dedicated instance for SRP. Public infrastructure is prohibited.
- D. Detailed audit logs must also be available to SRP.
- E. Applications will not have any licensing and will only have service level agreements.
- F. Any installed routers for data transfer to off-site service must be approved by SRP prior to approval
- G. The ability to increase storage space on any application must be available to SRP at any time during the SLA.
- H. If option is available, the storage location for off-site storage must be the closest in physical location to SRP.

PART 3 - EXECUTION

3.1 SAAS/CLOUD PRODUCTS

- A. SLA agreements will be signed by SRP and can be canceled by SRP at any time with no penalties or fees.
- B. SRP will have full access rights available to customers for SaaS or Cloud service.
- C. Any product installation must adhere to the following sections:
 - 1. 25 10 00 Network Equipment
 - 2. 25 12 00 Network Configuration
- D. For internet connections for data transfers, SRP must be supplied with the HTTPS address to be placed on the ALLOWED List.
- E. Any services that will need to be run on the server will need to be pre-approved by SRP, and proper access will need to be granted to the approved Controls Contractor user to set up the services.

3.2 SUPERVISORY SOFTWARE

- A. Supervisory software must be installed by Controls Contractor who is a licensed representative of the product.
- B. Software being installed must be the newest version available, and must be updated to the newest available version as stated in section *25 00 00 Integrated Automation*
- C. Any additional software required for configuration or maintenance must also be installed on the same server as the supervisory software.
- D. Install files, updates, and patches must be stored on the server that they are installed.
- E. Any access to the internet for updates or access for remote support external to the Controls Contractor approved for the project is prohibited.
- F. SRP will have administration account created in any installed supervisory software prior to project close-out, and all generic and default accounts will be deactivated or removed.

3.3 DEVICE CONFIGURATION/PROGRAMMING SOFTWARE

- A. Any software required for installed field device programming, configuration, or maintenance will be installed on an SRP server as part of the project.

- B. If an older version of software is installed and the newer version will have an adverse effect with existing device connections, both software will need to be installed in parallel if existing devices cannot be upgraded as part of project.
- C. If parallel versions of software are installed, documented step-by-step on switching between and using both software must be presented to SRP at close-out and demonstrated in training session.

3.4 NIAGARA DATA INTEGRATION

- A. Data integration into the Niagara Supervisor will be completed by the Contractor.
- B. Any device names or object names that cannot be renamed internal to the device to match the SRP Object Naming Standard must be documented as stated in section 25 00 00 *Integrated Automation*.
- C. Any device or object naming that does not match the approved or is noted in the documents provided for renaming from the Controls Contractors will be the responsibility of the Controls Contractor to resolve at no additional charge.
- D. Trending will be discovered into the Niagara Supervisor and set up to import every 30 minutes. Meta-data tagging for history grouping will be added as stated in the SRP Graphic Standard
- E. Notifications will **NOT** be discovered into the Niagara Supervisor and will instead be recreated as Niagara Alarm Objects matching the alarm configuration classes in the SRP Graphic Standard.
- F. Schedules will be discovered into the Niagara Supervisor, and BACnet export linked to the appropriate Niagara Schedules, set up to export every 15 minutes.
- G. Navigation trees (.nav files) will be updated to include all new graphics and mappings and will match the existing Navigation Trees and as laid out in the SRP Graphic Standard.
- H. Graphics will be completed using the SRP standard graphics, and as laid out in the SRP Graphic Standard.

END OF SECTION